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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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BRIEFLY TOLD.

DEATH OF MR. ROBERT SHERRARD, JR.—The latest gap in the active ranks of which we are advised is that caused by the death, on the morning of the 8th inst., of Mr. Robert Sherrard, Jr., President of the Steubenville (O.) Gas and Electric Light Company, and a prominent member of the Ohio Gas Light Association. Next week we hope to print the story of his life, mainly through the courtesy of Mr. J. Gwynn.

MR. BUTTERWORTH'S PAPER ON THE POSSIBILITIES OF GAS AS AN AID TO VENTILATION.—Mr. Irvin Butterworth, of Columbus, O., whose services of the solid sort, in connection with the betterment of the Ohio Gas Light Association, are pretty well remembered, read a very interesting paper, last month, in Philadelphia, before the American Association, the chief merit of which may be said to be that he appealed to generality rather than particularity for the support of his argument. Mr. Butterworth, however, speaking out with the knowledge born of experience, manages to put himself on the record of the day clearly enough in favor of causing the lighting burner of our time to act as a flue in the open, aided, of course, by suitable mechanical device; wherefore, we say, passing on to heating burners and heating stoves, that, if gas is to be caused to play a prominent part in the warming of our rooms, intermittent or steady, a flue connection must be arranged for. This understanding, and without doubt it must be eventually arrived at, will do away with heaters of the Backus stamp, set without respect to the transmission of their vitiation products to the open air. The main difficulty in respect of ventilation by gas heat, *per se*, is not so much nowadays in the cost of the fuel as in the waste which lies in the correct use of the warmth produced. Gaseous heat is the true heat and the controllable heat, but the average house of our day is not of the type that will enable gas makers to show their product in this respect at its best. If the last remark may be permitted to go, the difficulty for solution would seem to be the changing of the house to suit the present knowledge of heating it by gas; but as the evolution of the house antedated the generation of gas, the sellers of the latter may well rest content to wait for the house to improve in an unevener and slower ratio than that shown by the improvement in gas supply. After it has all been looked over, even after consideration has been given to the "wonderful developments" in incandescent electric lighting during the past five years, and notwithstanding the seemingly gloomy tone which marks the preceding sentences in respect of heating by gas without the aid of flue connection, the dull November fact remains that gas men are nearer to heating houses by means of gas than the electricians are to lighting them by means of their incandescent fibers. Mr. Butterworth, however, has shown himself to be a close student of the many odd phases in gas supply that have confronted him in Columbus; and, without much solid sustaining from his home authorities, has kept himself honestly abreast of the best gas practice of the current day. From all of the above we are not to be recorded as against the belief that ventilation by gas is an impossibility. Not so; we believe it has already been virtually accomplished, through the agency of the incandescent gas burner, so far as illumination is concerned, and simply because that pollution by this means of gas lighting is reduced

to the zero point, as near as one may care about. It is, of course, a pity that the incandescent system of gas lighting comes so high just now, in respect of the cost of the apparatus that gas men may employ, because of the profits that the owners of the patents are reaping; but when the time of their garnering is ended—and it is questionable whether the patents can be perpetuated beyond their initial life—all may, and will, have a full share in the standing advancement that came to the gas business through Dr. Auer's studies. So, perhaps, if the clever gentleman from Columbus—and a clever gentleman he is—had addressed himself to the ways and means of ventilating gas heated rooms, he would have discussed a problem nearer to the gas maker's forward art than is the problem of their illumination.

NOTES.—A week ago we reported that Mr. William H. Merger was one of the gentlemen interested in the proposed Gas Company for Mt. Clemens, Mich. It is an easy thing, of course, to say that the types are responsible for errors; but whether the types were in this case chargeable for the misnomer or not, the fact remains that we should have printed this particular name, "William H. Morgans." We are more than satisfied over the outcome, however, since now we know that it is Mr. W. H. Morgans, of the L. R. Medbury Gas Works, of Pontiac, Mich., whom we miscalled. Mr. Morgans is, we might add, the Treasurer of the proposed Company for Mt. Clemens.——Miss Amelia Elizabeth Nicolai, daughter of Mr. and Mrs. Louis Nicolai, of Portland, Oregon, was united in marriage to Mr. Edward Francis Sherman, on the 2d inst. Mr. Sherman is the son of Mr. F. C. Sherman, of the New Haven (Conn.) Gas Light Company; and is also the Superintendent of the East Portland (Oregon) Gas Company.——The Tucson (Arizona) Gas Company has sufficient vitality within it to be concerned in the expenditure of a good round sum for the extension of its gas mains. Go, do likewise. It may cost a bit more to put down gas mains than it does to string electric lighting conveyers; but the former will last for many years, and will bring in vastly more money than the latter.——Some weeks ago a political upheaval—the Republicans succeeded the Democrats when the ballots were counted—occurred in Wheeling, W. Va., and new men were put in control of the Board of Trustees of the City Gas Works. The Board, on the 9th inst., caused the publication of the following in the local newspapers, which is given without comment, although it is printed as an evidence of how municipal gas supply is conducted:

To the City Gas Consumers: The undersigned beg to inform the public of the real reason why the city gas is so much tainted with sulphur. The sulphur has been in the gas for more than two weeks—fully a week before any of the new force had anything to do with its manufacture. The trouble is that the sponge now being used for purifying is about worn out and needs renewing—either this must be done or go back to the use of lime. The latter had been used as a purifier up to two years ago. Either of the remedies would necessitate an outlay of more than $500, and the Trustees do not wish to incur this expense now, in view of the near completion of the new process, which Mr. Harvey expects to put in operation within ten days or two weeks. If this new process is a success there will be no use for purifying boxes at all. In the meantime the Trustees, who are acting in the public interests, ask the indulgence of the consumers of gas.

E. BUCKMAN,
J. POLLOCK, } Trustees.
H. T. FORD,

FRANK H. THOMPSON, Supt.

The Market for Gas Securities.

Consolidated was very uneven in price during the week, having sold down to 146 and up to 149½, which latter was the figure at which the closing sale was made on the Exchange on Thursday. To-day (Friday) the opening came in dull, the nominal figures being 149¼ bid, offered at 150. Much curiosity, if not concern, is manifested regarding the action that the Company's executives will take in the instance of the next quarterly dividend, the time for declaring which is close at hand. It is said that the management are divided over the question, a very important minority being in favor of increasing the rate, while the conservative majority prefers to keep on at the usual return. While nothing positive can be said just now, we rather favor the view that the increase will be ordered. In any event, whether the rate is increased or not, the fact remains that the Company could easily pay 10 per cent., did it so elect, wherefore the shares look to us to be cheap at anything under 160.

Other city gas shares are dull and strong.

Brooklyn quotations are nominal in respect of the old securities, and 76 is bid for the new issue of the Brooklyn Union Company. Our item columns contain the details of the Brooklyn merger.

Chicago gas is weaker, and Baltimore Consolidated is a bit off, because of the likelihood that the overturn in politics there may cause adverse legislation in the matter of gas rates. The semi-annual dividend of 2½ per cent. on Baltimore gas is payable December 2d.

Lacledes are somewhat better, and the general market is steady to strong.

[Prepared for the JOURNAL.]

The Draughting Room a Necessary and Profitable Adjunct to the Equipment of a Well-Regulated Gas Works.

By MR. CHARLES P. RUSSELL.

In the equipment of the offices of any well-regulated gas company a draughting room should be included. No other department of a company's business can be made to give such profitable returns for the capital invested and the labor involved as this particular branch, especially in companies where the output is very large or even moderately so. I might go farther and insist that no company is too small to afford this adjunct, although there may be times when occasion for a draughtsman's service does not arise for several months.

In recounting the advantages to be derived, let us, first, take up the manufacturing branch of a company's business. Conceding the desirability, in fact, it might be said, the necessity, of having, first, a survey and plan of the plot upon which the buildings and holders comprising the plant are situated, this drawing should show all the building lines and the various distances therefrom of curb lines, and should embody such dimensions of the building walls and other structures upon the premises as to be sufficiently in detail to serve as a plan to the supplementary sheets showing the longitudinal and transverse sections. The latter should be in every respect the same as an architect's working drawing; in fact, so much so that every detail of construction is brought out and embodies in itself a specification of the conditions as they exist.

With the building plans in view, a plan of the apparatus and connections should next be gotten out. Starting with the generating apparatus, the location of the benches or generators, or both, in the case of a combination coal and water gas plant, should be shown; then the condensing, scrubbing and purifying apparatus, the station meter, holders and street pressure governor. The coal storage sheds, lime or oxide room, and all other portions of the plant previously outlined on the general plan, need not be detailed upon this plan except, perhaps, in the case of water gas or combination plant, where it is desirable that the connections between the storage tanks, oil pumps, feed tanks, meters and generating apparatus be noted. This detail should distinctly locate every joint of pipe, valve, T-piece, cross or bend from the take-off of the generating apparatus to the outlet of the street pressure governor. The method of connecting, whether by means of bells, sleeves, split sleeves or flanges, as also the direction of the bells, if such are used, should be shown, together with the distances thereof from the apparatus last connected. With this plan at hand, any alteration in the existing apparatus, or introduction of additional apparatus, can be readily mapped out and the exact dimensions of the necessary connecting pieces or specials be determined, thus saving the time and annoyance and possible danger of a long shut down otherwise incident to fitting the connections.

Having outlined the buildings and apparatus, we should now proceed to make a profile of the connections between the various apparatus. Having fixed upon a bench mark—which, of course, should be some permanent fixture and at all times accessible—the elevations of the pipes should be taken at distances of say every 10 feet. By this means the fall of the pipe is determined and, by reference to our drawing, we can instantly locate the probable spot in which a troublesome "kink" may have occurred, and be in position to quickly relieve our difficulty by the introduction of a drip-pot or other convenient means.

The apparatus and connections in the works being disposed of, the street mains should now receive attention. It is, perhaps, not necessary to urge upon your readers the advisability of having the street mains properly located. Our plans, profiles and cross sections of the distributing system should be minute in detail. The distance from curb lines should be shown on the plan, as also the exact location of every special drip-pot, lamp-post, house service connection, and stopcock. With a correct plan in our possession, we will be spared the vexatious experience, so frequently encountered, of having to tear up several yards of pavement before locating our mains. The profiles and cross-sections should give the various sizes of the mains and service pipes, their prox-

imity to water or other pipes, and the fall or drip per length, or per 100 feet of main.

Being now provided with general plans of our property, buildings, manufacturing apparatus and distributing system, we should next secure detail drawings of the various apparatus. It is generally conceded that the success with which a plant can be operated is largely dependent upon local conditions. Admitting this to be the case, it is evident that no manufacturer can design for us what is exactly suited to our conditions. We know or ought to know what is most to be desired, and if we can get out our own plans for the work, a material saving in cost and an absolute certainty of getting just what we want are assured. To be certain that our estimates are correct, we may submit blue prints of our drawings to several manufacturers in that particular line, knowing that one and all are bidding upon the same design. Those who have the daily operation of plants under their supervision are certainly better acquainted with the individual conditions and requirements, and should not look to the manufacturers to supply them with plans, and are certainly not justified in saddling upon our companies different types of apparatus that may not fill the office for which they were intended and which would consequently prove a dead loss to us.

Every piece of machinery we have in our works should have a detail drawing of its several parts. In the case of repairs many parts of an apparatus are apt to be removed and renewed that could be put in perfect condition, and hence entail an enlargement of our repair account that militates against the earnings of the works. In the writer's experience, estimates for repairs to several particular portions of plants have been submitted by the various manufacturers in which the figures have varied as much as 50 per cent. Now we all know that any such variations must be attributable to other sources than miscalculations. In most cases the lowest bidder is awarded the contract, and the high man, whose price was, perhaps, for something far in advance of what his competitor figured upon, is placed in a questionable position because of his seeming attempt at extortion.

The arguments presented have thus far been general, but their force will readily suggest itself, particularly to those who are located at a great distance from the manufacturing centers. In these cases the question of time, together with expense of transportation, is an appreciable item. Very often some special castings that are needed for immediate use could be gotten out at a local foundry if we had a drawing from which the founder could work. An experienced draughtsman would make a drawing so that the same foundry pattern would suffice for a variety of castings of the same design but of different lengths. Those who have had experience in this direction know that a number of our specials are not in accordance with the standards recently adopted by the manufacturers, and hence are not carried in stock and would have to be made especially for our particular needs, costing us as much for patterns and material as if they were cast at a local foundry. Add to this the time required for transit of an order through the mails, and the additional time and expense of freight transportation, we see that a saving could be effected that would pay a large proportion of the expense of a draughting room.

In conclusion, let us consider in addition to all that has gone before, that with a complete set of plant drawings before us, we can reflect upon any betterments that we may contemplate much more quickly and efficiently than by constantly going over the ground taking measurements, etc., and imposing upon our men annoying interruptions in their routine work, and perhaps returning to the office with a perplexing mass of ideas and dimensions that in all probability we could not get in tangible shape when we undertook to work them out. Many other minor advantages will suggest themselves to the readers of this article. It is not the intention to enlarge upon this subject too extensively, the field to be covered being so great that space forbids treating it in detail. We have endeavored to show the main advantageous features, the comparative ease with which the intricate details of many years' work and experience can be put before us at a glance, the facility with which our troubles from stoppages, etc., can be traced and remedied, the saving in expense that can be effected in proposed betterments, and the satisfaction to be derived from being enabled to estimate the cost of our repairs and extensions in accordance with our own individual requirements and receiving proposals for the work upon a uniform basis, the details of which emanate from the source best calculated to determine them.

A well equipped draughting office will prove beneficial to us in evolving new ideas that will tend materially towards developing the interest of our companies and enhancing the value of their properties, thus returning many times the comparatively small outlay required to establish and maintain it.

[Concluded from page 779.]

ABSTRACT OF PROCEEDINGS, TWENTY-THIRD ANNUAL MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION.

HELD AT CONTINENTAL HOTEL, PHILA., PA., OCT. 16, 17 AND 18, 1895.

SECOND DAY—MORNING SESSION.

APPOINTMENT OF COMMITTEE ON STANDARDS.

In consonance with the supplemental report of the Committee on President's address (*ante*, p. 727), the President appointed the following Committee on Standards, the Committee to serve for one year: Irvin Butterworth (Chairman, *ex-officio*), A. B. Slater, Jr. (Secretary, *ex-officio*), and W. R. Addicks.

The President then introduced Mr. Irvin Butterworth, of Columbus, Ohio, who read the following paper on

THE VENTILATION OF GAS LIGHTED ROOMS.

When Holmes's deacon set about building his famous "One-hoss shay" he uttered a piece of invincible logic, that is just as applicable to the gas business as it is to chaise building, when he said that "The weakest spot must stand the strain," and that the way to fix it is "To make that place as strong as the rest."

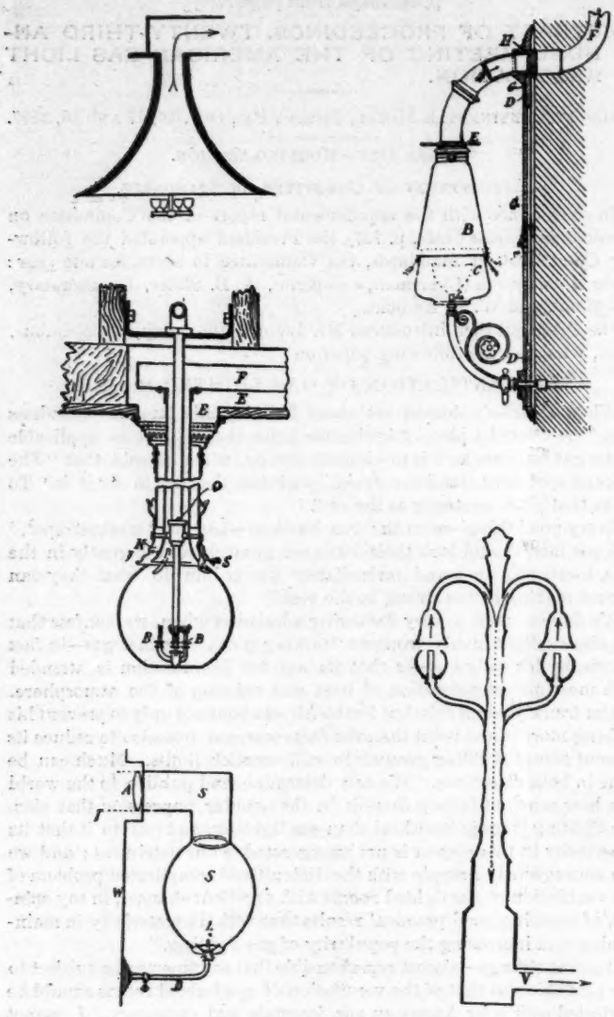
Every good thing—even the gas business—has its "weakest spot," and gas men should look their business squarely and honestly in the face, locate this spot and immediately proceed to do what they can toward making it "as strong as the rest."

We do not make a very damaging admission when we confess that the electric light man's strongest "talking point" against gas—in fact practically his only one—is that its use for illumination is attended with more or less generation of heat and vitiation of the atmosphere. Let us frankly admit this, but forthwith set about not only to prevent his making more of the point than the facts warrant, but also to reduce its present actual standing ground to still smaller limits. Much can be done in both directions. We can determine and publish to the world just how much of fallacy there is in the popular impression that electric lighting is more healthful than gas lighting, and see to it that its superiority in this respect is not exaggerated to our detriment; and we can courageously grapple with the difficult and complicated problem of the ventilation of gas lighted rooms with excellent chances, in my opinion, of securing good practical results that will aid materially in maintaining and increasing the popularity of gas lighting.

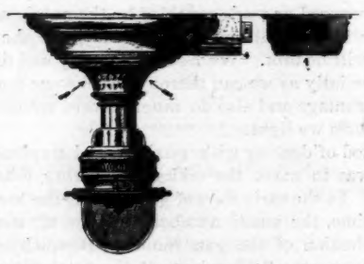
It seems strange—almost reprehensible that so important a subject to our profession as that of the ventilation of gas lighted rooms should be neglected as it is by American gas journals and engineers. I cannot find that it has been specially treated at any of our Association meetings or, in recent years at least, in any of our gas periodicals. And yet as a recent writer says, "A reliable scheme of room ventilation is the greatest need of the time," as far as the gas business is concerned. Can it be that gas men have given up in despair of anything further being accomplished in this direction, and tacitly agreed to maintain a discreet silence as to this "weakest spot" in the hope that happily it may not be discovered or made much of by the public whom we would serve! The electrician will hardly permit this, and the more silent we are the louder will he talk. We had better study and discuss the question boldly, especially as we can thereby dispel some popular delusions to our great advantage and also do much toward securing better ventilation of the rooms we light.

The old method of dealing with noxious and unpleasant effluvia in living rooms was to mask the odors by burning tobacco, lavender, cedar dust, etc. In the early days of gas lighting the low ceilings of the houses of that time, the small number and size of windows and the imperfect purification of the gas, rendered it much more necessary than it is now to remove the products of the combustion of gas lights. This was first accomplished not by ventilating the room as a whole but by devising self-ventilating burners, provided with caps, hoods, tubes, etc., for taking the combustion products directly away from each individual burner as produced, without allowing them to mingle with the air of the room. Such burners were first introduced over 60 years ago, Prof. Faraday being credited with the invention of the first one and being followed by Rutter and many others. A few styles of such burners are here illustrated as a matter of interest. (See page 812.)

The chief objections to these burners were that they were unsightly, expensive and troublesome, absorbed considerable light, gave off considerable radiant heat, were badly affected by down-drafts of air from the outside, etc. It is also apparent that they would do very little toward ventilating the room itself. It was in comparatively recent



years that ventilating gas lamps of the Wenham and Siemens-Lungren type, which remove the hot air from the room as well as the products of the gas combustion, were first devised, Mr. B. H. Thwaite claiming priority over other inventors of such lamps. Such a lamp is here illustrated.



There is no question whatever but that these ventilating gas lamps furnish an absolutely perfect means of simultaneously lighting and ventilating rooms and incidentally preventing the blackening of ceilings. They have received the enthusiastic praise of the most eminent gas engineers and scientists. With two such lamps Mr. Bandsept extracted 5000 feet of air per hour from a room, the temperature of which increased only 4° F. after the lights had burned for four hours. Prof. Lewes extracted 5000 feet of air per hour with one lamp, and also found that the radiant heat from such a lamp raised the temperature, at a point 5 feet below the lamp, only .2° F.; while Mr. Simmance secured ventilation so efficient that the temperature increased only 1° F. after hours of lighting; and he goes so far as to say that such lamps can be made to carry off 3,000 times as much air as there is gas consumed. A lamp burning 16 feet per hour would therefore be able to extract 48,000 feet of air per hour. Practical tests of these lamps have repeatedly and abundantly demonstrated that the same gas that will adequately light a room will at the same time adequately ventilate it, and that the lighting and the ventilating are both better done than is possible when electric light is used. Installations of such lamps have been in successful use for years, securing, in the most perfect manner, throughout the entire period, thorough ventilation combined with the greatest economy of lighting short of that obtained by the Welsbach burner. In the face of all these facts, the ventilating gas lamp has utterly failed of general adoption. Its use has been very limited indeed. The only possible objection that has been urged against their efficiency is that they do not ventilate except at night when they are lighted. But it is not to this deficiency that we must look for an explanation of their lack of popularity. The cause lies in the simple but significant fact that their installation is somewhat expensive and troublesome. Vigorous efforts have been made to introduce them in this country, but it was found that the general public had a much greater appreciation of the almighty dollar than of the comforts and healthfulness of proper ventilation. As a matter of fact, too, it must be admitted that these lamps are scarcely adapted to lighting dwellings. They are hardly sufficiently ornamental; the light is too strong, or concentrated; they are difficult and expensive to install in existing houses; require the construction of tubes and flues, and careful provision by means of cowls, talc discs, or valves of mica or oiled silk, against down drafts that would be fatal to their working; the tubes carrying off the products of combustion must be carefully enclosed in non-conducting and fire-proof material; a trap with self-closing overflow must be provided for the moisture condensed from the products of combustion, etc. So while these lamps are a mechanical success, yet the difficulties, expense and care incident to their installation and use—chief among which is that the public are not educated to an appreciation of their advantages—are such as to militate against their general introduction.

It is therefore some simpler more easily applied means of ventilating gas lighted rooms that we must seek if we are to have its adoption sufficiently general to materially strengthen the one "weakest spot" that is still urged against gas lighting. Of course mechanical ventilation, by means of fans, exhaust stacks, etc., is applicable and perfectly successful in the case of large or public gas lighted buildings. For instance the theatre at Nice, France, is (or at least was until recently) lighted exclusively by gas, 1,700 burners being used, and yet it is ventilated by mechanical means so efficiently that as disinterested and competent an authority as the *Builder* says the theatre is delightfully "fresh and comfortable." But the desideratum is a method of ventilating small living rooms, store rooms, etc., where most of our gas is consumed (or ought to be) and where mechanical ventilation is out of the question. And this brings us face to face with the study of the problem of ventilation.

In the first place I think we shall find that two or three popular fallacies exist on the subject, and it is our first duty to expose them: 1, that electric lighting is more healthful than gas lighting; 2, that CO_2 is extremely dangerous; and 3, that CO_2 is the measure of impurity in the air of gas lighted rooms. We will consider them in turn.

1. It is popularly believed that the atmosphere of an electrically lighted room is more wholesome than that of a gas lighted room; and electricians take advantage of the "panicky" nature of the public mind in matters pertaining to health to encourage this belief. As a matter of fact, there are no records of any tests or experiments supporting it. No thorough and scientific comparison has ever been made, that I can discover, of the healthfulness of the atmosphere of a room lighted by the different methods; nor are there any available data showing that better health prevails after changing from gas to electric lighting. The assumption is, of course, based upon the theory that in a room lighted by gas there are injurious products of its combustion, while if lighted by electricity the air remains pure. The assumption, however, is incorrect. It is not true that the products of combustion of well purified gas are exceedingly injurious, or that they accumulate in an ordinary room under ordinary circumstances in sufficient quantity to render the atmosphere unhealthful. One authority has said, "A room in which the air can be sensibly vitiated by an open gas burner is not fit for habitation for any length of time by human beings." In other words, such a room needs ventilating whether lighted or not. On the other hand, the air of an electrically lighted room is by no means pure if the room be occupied, and it becomes especially foul near the floor, where the occupants live and breathe. In the case of a gas lighted room the heat from the burners induces currents of air that carry up with them the products of respiration and noxious effluvia from the bodies of

the occupants and dissipate them through the upper parts of the room, where the heated moisture from the burnt gas absorbs and holds them near the ceiling, leaving the air in the lower part of the room pure. Whereas, in an electrically lighted room no air currents are established (on this account Mr. Simmance says "The absence of heat is a great disadvantage in electric lighting"), and the exhalations from the lungs and bodies of the occupants rapidly fall and impregnate the lower portions of the room where the occupants breathe. Cold air is not necessarily pure any more than warm air is necessarily impure; and there is abundance of good authority for the statement that as far as healthfulness is concerned there is fully, if not more, need for ventilating electrically lighted than gas lighted rooms. We also have good authority for the statement that, in the former, chilly and disagreeable drafts from the ceiling are frequently experienced, endangering the health of the occupants. As the ceiling of a gas lighted room is kept warm, this danger cannot there exist.

2. While CO_2 has always been considered an extremely dangerous ingredient of air for breathing purposes, it is now being discovered that when pure and free from animal exhalations, as in that produced by gas combustion, its percentage can be increased with impunity much beyond the limit formerly fixed as the danger line. Many authorities could be quoted to prove this, but the following, from Thomas Fletcher, F.C.S., will serve as a sample: "It has for many years been well known to experts that a very much larger proportion of CO_2 than usually exists in the air, can be inhaled without any injurious effect, and that this gas is really as inert as nitrogen; but Dr. Haldane's researches show clearly that an excessively large proportion of CO_2 may be inhaled with ordinary air without risk and with little discomfort. Ordinary fresh air contains about 1 part of CO_2 in 3,000; yet this may be increased a hundredfold before any difference can be appreciated in the respiration, *i. e.*, the presence of 3 per cent. of this gas—100 times the normal quantity—can only be appreciated by a chemical analysis, and not by persons breathing the mixture. Foul air in a room is not dangerous from any quantity of CO_2 which can be formed by combustion until the combustible itself is extinguished, owing to want of oxygen. Human beings can live and breathe in an atmosphere which will not support the combustion of a candle. We may safely take it for granted that any amount of CO_2 formed by the combustion of coal gas in an ordinary room, under ordinary conditions, would be inappreciable, except to delicate chemical analysis." If, therefore, our gas is kept free from sulphur compounds (an exceedingly important matter, by the way, in this connection), there can be no real ground for the assertion that the products of its combustion for lighting purposes, under ordinary circumstances, are unwholesome, it having been amply demonstrated that no CO is produced when proper burners are used.

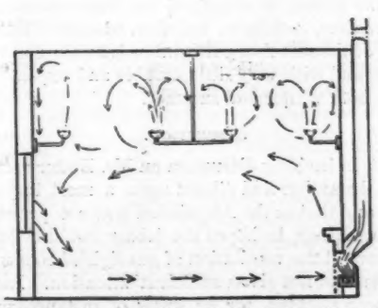
3. The explosion of the second fallacy also demolishes the third. CO_2 cannot be taken as a measure of the impurities in the air, at least in gas lighted rooms. The really harmful impurities in the air of rooms comes from the respiration of the living occupants and the emanations from their bodies, which, besides being foul in themselves, also constitute a ready carrier for oxidizable organic matter and the congenial home of micro-organisms, especially bacteria. In the moisture condensed from these exhalations have been found water, carbonic acid, ammonia, sodium chloride, uric acid, urate of soda, urate of ammonia and various extremely poisonous alkaloid and albuminoid substances. The exceedingly toxic character of these exhalations is shown by the fact that minute quantities of the moisture condensed from them have been administered to small animals with fatal effect. Every person thus gives off to the air each day more than enough poison to cause his own death if it could be collected and taken at one dose. It is apparent that the air of a room lighted with gas but unoccupied might become excessively charged with CO_2, but that it would nevertheless not be so impure as that of a room filled with people, but with no gas burning (or lighted by electricity), in which the percentage of CO_2 would be considerably less.

Having indicated three directions in which we may work to demonstrate that our "weakest spot" is not nearly so weak as our competitors would represent it, let us see if something cannot be done to make it still more nearly "as strong as the rest."

Unquestionably the *heat* produced by gas lighting is a far more popular objection to it, and a much greater impediment to its increased use, than its alleged unhealthfulness. Only electricians and theorists complain of its insalubrity, while all unite in condemning its heat. Remove the heat and there would be practically no complaint or thought of the products of combustion. And yet the heat is of great advantage, as I have shown, in promoting air currents favoring ventilation and in holding the products of respiration and body exhalations near the ceiling, out of the zone of breathing, and in preventing cold drafts from the ceiling. It is also of actual advantage, in this latitude, for six months of the year, as an aid to warming our rooms, a neutral factor for probably three months more, and only during about the remaining three months can any valid objection be made to it. Nevertheless, we must all admit that our position would be much strengthened if more of the energy of gas combustion could be converted into light. The Welsbach burner goes far in this direction, and this constitutes one of its strongest claims upon our favor. Light for light it produces only one-fifth the heat (and products of combustion) of an open burner, and only 3½ times the heat of an incandescent electric light. This is saying a great deal, but unfortunately these burners are not as yet in universal use; and even they, in the absence of proper ventilation, produce sufficient heat to be objectionable in very hot weather. An experiment made this summer at Columbus showed that the temperature of the air in a certain drug store was 10° F. higher when lighted with Welsbach burners than when lighted with incandescent electric lights, other conditions remaining the same, except that the former gave a better illumination; and when the mercury is already in the 80's, an additional 10° is like the traditional inch on the end of a man's nose—very noticeable! In private dwellings especially, where the rooms are small and usually no provision whatever is made for ventilation, does the heat produced by gas lighting restrict its use. The practical problem before us, therefore, is the devising of means and methods of carrying off the heat of gas combustion, that will be simple, inexpensive and adapted to general introduction and use; and also the educating of our consumers to intelligently avail themselves of the means thus offered. I do not believe all this is "past praying for," as a late writer on the subject, while emphasizing its importance, despairingly remarks.

Briefly stated, proper ventilation consists of changing the air of a room sufficiently often to keep it approximately pure, and comfortable as to temperature, without the creation of drafts and with a minimum loss of heat. An adequate discussion of this interesting and important subject is beyond the scope of this paper as well as of the ability of the writer. The author of a modern work thereon has confessed that "theories of ventilation are as numerous as the trees of the forest;" and after reading the arguments of the advocates of opposing systems we really begin to sympathize with the old farmer who complained that hearing both sides of a question always confused him! All authorities agree, however, that it is an intricate and difficult problem requiring much knowledge and skill in its practical solution. No two cases are alike, and each must be specially studied and treated. It is impossible to lay down any hard-and-fast rules for universal application, as there are so many circumstances and conditions affecting the problem; for instance, the character of the building as to size, purpose and construction; the size and location of the rooms; the time of day or of the year, or both, when the room or building is to be occupied or ventilated; the number of occupants in relation to the size of the room; the methods of heating and of artificial illumination; the exposure of the building to winds, etc. Under the circumstances, it is no wonder that "doctors disagree" on many questions pertaining to ventilation; but it is nevertheless rather surprising that even one so fundamental as to whether the foul air should be abstracted at the ceiling or at the floor (the conditions being given) should still be in dispute. In a recent number of *Heat and Ventilation* two authorities are still wrangling over this time-worn question.

Whatever may be the proper location of the foul air outlet under other circumstances, however, I am quite sure that almost all authorities would agree that in the case of gas lighted rooms it should be at the ceiling, and that there should be only one such outlet. Also that the fresh air inlet or inlets should be at or near the floor. The following illustration shows, upon the authority of the late Prof. Jacob, the air



currents in a room lighted by gas and heated by an open fire place and ventilated only by it.

Evidently the fire place does not remove the hot foul air from the room to any extent. It remains at the ceiling, and this would be especially the case where hot-air furnace heating employed, now so generally used in the United States. On the occasion of an evening party or reception, when all the lights would be burning, the removal of the hot air at the ceiling would be especially desirable. Opening the windows at the bottom would only bring in a stream of cold air at the floor and directly against the occupants. Opening them at the top would not allow the hot air to escape without producing a dangerous and uncomfortable cataract of cold air upon their heads, unless muslin screens be stretched across the upper part of the open windows, as is suggested by one writer on this subject. But it is obvious that what is needed is an outlet for the hot air near the ceiling into some interior upright shaft, say the chimney flue, or, better still, into an independent shaft built alongside of, or within, the chimney. If this outlet should be provided with a proper valve, or damper, controllable by cords or otherwise (for no system of ventilation can be automatic), the ventilation can be easily regulated and the room be kept comfortable under practically all circumstances.

Every house should have such a central shaft (for it should never be at an outside wall) with a ventilating outlet leading into it from near the ceiling of each room. The outlets can be easily concealed by pictures, and in existing houses the cost of putting them in would be trifling if made to open into the chimney.

With such provision for ventilation the air of a gas lighted room need not be changed nearly so often, in order to insure healthful and comfortable conditions, as the books on the subject state to be necessary, for the air is not *diluted* into purity, but the impurities are immediately carried off as rapidly as they are produced and are not allowed to mingle with the air of the room; and for the same reason the ventilation is accomplished with a minimum loss of heat and therefore with maximum economy, and without the creation of drafts.

If inlets for fresh air are needed—say in case the hot air from the furnace is shut off—the simplest and therefore the best plan in existing houses (and these are the kind we must largely deal with) is to raise the lower sash of the window slightly, having provided an extra high "bead," or molding, at the window sill to prevent the cold air from entering at the bottom and striking directly against the occupants of the room. The air will then enter between the "meeting rails" of the two sashes and be directed slightly upwards, so that it will not fall directly upon the heads of the occupants but be made to diffuse itself gradually through the room.

If a central ventilating shaft independent of the chimney is provided (and gas men should see that this is done in all new houses), provision should be made for either carrying the flue of the cooking range along side of it to keep it warm, or burning a jet of gas at its base, as occasion may require, in the summer time and when the house is not artificially heated, in order to induce a draft therein, if necessary; and another outlet for foul air should be made into it from each room near the floor, for use in ventilating in the day time (especially in the summer season), when the rooms are not lighted but occupied.

The above suggestions are not based upon theory but on the success of the plan advocated, where it has been adopted. If some such simple means were generally provided and used, fewer stores would be lighted by electricity and fewer people would spend the hot summer evenings on the front steps of their unlighted houses.

There is no work which this Association could easily do that would be more conducive to increased gas sales than to appoint a competent committee to prepare simple but detailed rules for the ventilation of gas lighted rooms, publish them in the gas journals or by the distribution of pamphlets to our members, and so put into the hands of every gas manager the means of educating his own community, through newspapers, circulars, architects, builders, educators and lecturers, to the knowledge of the fact that gas lighting is no more unhealthful than electric lighting and with very little trouble and expense can be made as comfortable, both winter and summer.

Discussion.

The President, in inviting discussion on Mr. Butterworth's paper, remarked that as the author had dilated upon a most important and interesting topic, and that as the Association was not pressed for time to complete its proceedings, he hoped the debate would be exhaustive.

Mr. Egner thought the ventilation of gas lighted rooms was a matter to which gas men had not given sufficient attention. Indeed the subject had often been slighted, for he knew of instances where users of gas stoves had been told that it was of slight consequence whether set provision was made for the ventilation of rooms in which gas heaters were discharging combustion products. The Norfolk (Va.) Company was constructing a new office building, which it was proposed to heat by means of gas, the heating apparatus to be chiefly of the radiator type; but ample provision was to be made for suitable ventilation.

Mr. McIlhenny said it was generally conceded that the best ventilated meeting room in Philadelphia was the Hall of the Franklin Institute, which ventilation was carried on the air duct plan described by Mr. Butterworth. He also understood that the Halls of the English Parliament buildings were rendered perfectly habitable by the sensible system of gas ventilation there practiced. Beyond a doubt gas men should pay more attention to this matter than they have hitherto given to it. He (Mr. McIlhenny) also heartily approved Mr. Butterworth's suggestion for the preparation by the Association of a set of rules respecting ventilation by gas, which rules should be placed in the hands of architects and builders the country over.

Mr. Littlehales indorsed the paper and the opinions thereon of the previous speakers; and he would add that the Masonic Hall, in Hamilton, Canada, afforded an excellent example of the success attendant upon gas as an aid to ventilation. Prior to the system now in successful vogue there many of the rooms were the reverse of comfortable; in fact they were unwholesome. Gas ventilation, however, had changed all that. He would like to indorse emphatically the rule system proposed for the enlightenment of architects and builders.

Mr. Ramsdell referred to the success which attends the system of gas ventilation practiced in France, in which country many buildings devoted to public use (notably schoolhouses) were heated and ventilated by means of gas. He joined the writer of the paper and the previous speakers in their advocacy of getting architects interested in ventilation by gas.

Mr. J. J. Humphreys was unable to comprehend Mr. Butterworth's reference to the difference in the products of combustion given off by the Welsbach burner and an ordinary open flame burner, the comparison being made on the quantity of gas respectively used by each.

Mr. Langford described a personal experience which seemed to him to prove that common sense was all that was needed to secure comfort and good atmospheric conditions in any room lighted by gas. His library room, or den, was lighted by gas and sometimes the air became very oppressive. He thought, at first, of trying incandescent electric light, but eventually set a ventilator hood at the proper height, above the burners, and connected the vent of the hood to the chimney flue. He also adjusted the window sashes quite like the plan suggested by Mr. Butterworth, and now enjoys perfect comfort "in his den."

Mr. Jas. Somerville thought the thanks of the Association were due to Mr. Butterworth for his sensible and timely paper, and hoped that the Association would carry out the idea of framing rules, in respect of how ventilation by means of gas flames could be accomplished, and then seeing to it that the leading architects of the country were apprised of the existence of such rules. The speaker then described the plans under consideration by the Indianapolis Gas Company for the ventilation of its new office building, now in course of erection, which would, of course, be lighted throughout by means of gas.

Mr. A. C. Humphreys thought that the topic of Mr. Butterworth's paper, which had been so admirably handled by him, was bound to be a striking and current one in practical gas supply. In fact, gas engineers should make it so.

Mr. Butterworth answered Mr. J. J. Humphreys' comment by saying that, light for light, yielded respectively by the Welsbach and the open-flame burners, that the products of combustion from the former and the latter were as 20 is to 100.

On motion of Mr. A. C. Humphreys, a vote of thanks was tendered to Mr. Butterworth.

On motion, a vote of thanks was tendered the Backus Manufacturing Company for an invitation to visit its works, and to inspect its exhibit.

The President then opened

THE QUESTION BOX.

Seretary Slater read as follows:

> Question No. 1. "In making up screwed or surface joints, what are the conditions that make advisable the use of red lead; and what are the conditions that make advisable the use of white lead? In other words—when should red lead be used, and when white lead?"

Mr. Egner objected to the use of either color of lead, for he believed that a good die meant a clean thread, which, if larded and screwed

tight, would furnish a sound joint. He would like to know whether a screw or flat joint was meant.

The President thought the query referred to both sorts of joints.

Mr. Forstall agreed with Mr. Egner, for certainly in the case of a screw joint he would not favor red or white lead. In Newark they used graphite in jointing.

Mr. Chollar preferred red lead for rigid joints, and white lead for soft jointings.

Mr. Smith favored an asphaltum made by a certain firm of paint manufacturers, particularly in joints on pipes used for conveying oil.

Mr. Crowell's practice was to use a paste of red lead and shellac on joints of any description.

Question No. 2. "About what is the average error of dry meters, not counting in meters 100 per cent. slow—or non-registering meters."

Mr. McMillin said that after the State of Ohio passed a law requiring the inspection of all gas meters by State Inspectors, the test of all the meters in use in Columbus, made under the provisions of that law, showed an average of .47 per cent. slow.

Mr. McDonald thought the question could not be answered off-hand, as locality and practice were the all-important considerations. He thought, however, that an examination of a large number of meters would show a general average closely approximating to correctness.

Mr. McIlhenny thought Mr. McDonald's remark as to locality and practice was very well put. Meters frequently tested, or within rational periods of use, would average better than those entering into an average made up of meters that were not examined until they had been complained of. He knew of 3,000 meters that had been tested within a twelvemonth, the average period of use per meter being perhaps five years, and the test figure was .25 per cent. slow.

Question No. 3. "What is the average error of wet meters, not counting non-registering meters?"

Mr. McDonald gave it as his opinion that the difference in accuracy of registration between wet and dry meters is virtually nil. Perhaps the error in percentage was greater in wet meters than in dry ones.

Mr. Baxter said that the Halifax Company used probably a greater number of wet meters than any other Company in the country, and he thought the main difficulty with them was their tendency, in case of a long continued use without inspection, to run fast. Take it all-in-all, however, from his experience, wet meters properly looked after and properly located, would live closer to accuracy during their fair life time than dry meters would.

Mr. McDonald thought, despite Mr. Baxter's reasons, that wet meters would show greater variations than dry ones, because of the fluctuations from exactness of the water level or line.

Question No. 4. "Do meters removed from service average against consumers or against the Company?"

Mr. Butterworth said the experience of the Columbus Company showed the average running to be against the Company.

Question No. 5. "In ordinary commercial practice, what is the basis for correction of volume of gas under varying temperature? What is the co-efficient?"

This question was debated by Messrs. Chollar, Miller, Thompson and Neal, but as their speeches consisted largely of references to formulas, it was impossible to report their remarks accurately, depending solely for their rendition on long hand notes.

Question No. 6. "In the last question above, in the gases in a holder is the barometic pressure an important factor; and, if so, in what ratio?"

Messrs. Somerville, Chollar and A. C. Humphreys discussed this question. Our remarks respecting Question No. 5 are applicable to this one also.

Question No. 7. "In the multitubular gas condenser, what is the minimum economical amount of cooling surface required per 1,000 cubic feet of gas; and under ordinary conditions how much water should be used per 1,000 cubic feet."

The President thought every man present would have his own opinion about that question.

Mr. Egner said he got along very nicely with 3.5 cu. ft. as to surface. He did not remember the figures respecting the water quantities.

Mr. Miller thought as did the President respecting Question No. 7.

Question No. 8. "Which is the better; to pass the gas through or around the tubes?"

Mr. Thompson detailed his experience at St. Louis, where both methods, as outlined in the question, were followed. He thought either plan gave sufficiently satisfactory results, where neither sediment from the water used nor deposition of tar figured as disturbing factors.

Question No. 9. "How much tar is produced from gas oil in the Lowe apparatus, and what can be done with it?"

Mr. Pratt obtained an eighth of a gallon of tar per gallon of oil used. They mixed it with breeze for boiler fuel.

Mr. Miller thought the tar could be burned to advantage with the aid of a special form of hydrocarbon burner. He had no trouble in separating it by settling to perhaps 1 per cent.

Question No. 10. "Which is the better practice, to run fresh water to the hydraulic main, or the water from the scrubbers?"

Mr. Mitchell remarked that the scrubber water would possibly result in the securing of anhydrous liquor.

Question No. 11. "Which will give the best results on holders, oxide, lead or graphite paint?"

Mr. Somerville favored graphite paint.

Mr. A. B. Slater, Jr., said the practice at Providence was to use graphite paint or oxide, to the exclusion altogether of lead paint. He preferred the oxide article always where the iron surface to which it was to be applied was perfectly clean. In fact, his preference in general was for oxide paint.

Mr. Egner remarked that he knew of holders that, during 30 years' life, have never been covered by anything in the shape of paint other than coal tar. He did not claim that the tarred surface was particularly handsome, but the iron was protected at a very low cost.

Question No. 12. "What is the usual practice as to 'cleaning up' stocks of coal and coke? How much of a difference from original weights is permissible?"

Mr. Somerville thought 2 per cent. would be the fair allowance in the instance of coal, and 10 per cent. on coke—the latter figure was approximate, depending upon whether the coke was stored or whether it stood in the open.

Question No. 13. "Our technical books cite larger losses in the gas making values of coals stored in the open air. With American coals are such considerable percentages of losses actually suffered in practice?"

Mr. Chollar said the loss noted in actual experience varied with the coal and varied greatly. For instance, the loss chargeable in this item to the Pittsburgh coals was very small, while in some of the West Virginia coals it was sometimes quite large.

Mr. Thompson thought that coals stored in the open air would naturally suffer loss in weight from disintegration, and that the coke product would also be affected as to quality. This was especially so in respect of the West Virginia coals, as Mr. Chollar had said.

Mr. A. B. Slater. Jr., said a good test in this line had been accomplished at the Providence works. They had received about the same time shipments of coal from the Pittsburgh and West Virginia regions. Owing to the exigencies of the case, parts of each shipment were put in the sheds and parts of each were piled out of cover. After a year's time it was found that the out-of-door stacks had been affected in different ways. The Pittsburgh coal showed no appreciable difference, either in weight or the quality of gas produced from it, whereas the other coal shrank perhaps 5 per cent. in weight and the quality of gas coming from it was something less than a candle of its usual value.

Mr. Somerville suggested that the main cause of this difference was in the fact that the West Virginia coals were sent to market in lumps smaller than the Pittsburgh varieties, which accounted for the greater ease with which disintegration took place in the former than in the latter.

Mr. Egner said that Mr. Somerville had anticipated him in what he proposed to remark.

Mr. McMillin thought that a record for reference in this matter had been made by General Hickenlooper, when that gentleman submitted a series of tables[1] to the Ohio Gas Light Association, on the subject of loss in weight of coal from a storage of six months, etc.

Question No. 14. "What is the best form of valve or cock for service connections to meters?"

Mr. A. B. Slater, Jr., said the plan favored by them was a cock with a hollow plug well greased. They screwed it in on top, and when the screw was turned the grease was so distributed that the slightest pressure would be sufficient to cause the valve to act. After standing for

1. See JOURNAL, June 2, 1885, p. 283.

two years, no difficulty was experienced in moving one of these cocks without the intervention of a wrench. These cocks are provided with hand wheels, and are often used for water stops.

Vote of Thanks.

The President announced that the questions had all been discussed. Thereupon Mr. Egner asked whether he was right in believing that the *Quarterly* was to be discontinued, and the President replied that the *Quarterly* would end with the next number, which would in the ordinary way be the last issue for 1895. The practice for the future would be to issue an annual volume, directly after the annual meeting.

Mr. Egner then moved a hearty vote of thanks to Mr. Slater, Jr., for the excellent manner in which he had edited the *Quarterly*, which editing meant the expenditure by him of much thought, time and labor. The motion (seconded by Mr. A. C. Humphreys) was put and carried. Mr. Slater acknowledged the vote, and the President called for the

Report of Committee on Next Place of Meeting.

The Committee reported in favor of St. Louis, Mo., and the recommendation was accepted and indorsed.

On motion of Mr. Nettleton, a rising vote of thanks was tendered (the motion was put by President-elect Humphreys) to President Clark and Secretary Slater. The latter responded for both in terse and clever speech. A cordial vote of thanks was then tendered to the Committee of Arrangements.

Mr. McIlhenny hoped that the Association would do something positive in the way of getting Mr. Butterworth's paper on "The Ventilation of Gas Lighted Rooms" before the building interests of the country, and suggested that an effective way to do so would be to empower the Secretary to print a certain number of copies of the paper, to be purchased at a fixed price by gas companies desiring the same, the purchasers to see to it that the copies would go into the hands of the architects and builders in their respective localities. After the President, Mr. McMillin and Mr. Butterworth had discussed the plan proposed, it was resolved that the Research Committee be instructed to prepare as soon as convenient a paper on the lines suggested by Mr. Butterworth, to be distributed eventually on the basis proposed by Mr. McIlhenny.

On motion of Captain White, the Association took a recess until the evening of Friday, with the understanding that final adjournment was then to occur.

ROLL CALL.

The following members attended the meeting:

Honorary Members.

A. R. Foote, Washington, D. C. E. G. Love, New York City.

Active.

Addicks, F. P., Boston, Mass.
Africa, W. G., Manchester, N. H.
Amory, Dr. R., Boston, Mass.
Archer, B. F., Camden, N. J.
Atwood, H. A., Plymouth, Mass.
Barrett, W. E., Ardmore, Pa.
Battin, I., Omaha, Neb.
Baumgardner, J. H., Lancaster, Pa.
Baxter, I. C., Detroit, Mich.
Baxter, R., Halifax, N. S.
Beadenkopf, G., Baltimore, Md.
Beadle, A. B., Milwaukee, Wis.
Beal, W. R., New York City.
Betts, E., Wilmington, Del.
Bigelow, A. F., Allentown, Pa.
Blodget, C. W., Brooklyn, N. Y.
Bodine, S. T., Phila., Pa.
Borgner, C., Philadelphia, Pa.
Bowen, W. S., Philadelphia, Pa.
Brown, E. C., New York City.
Buckman, J., Philadelphia, Pa.
Bush, J. S., New York City.
Burke, J. E., Princeton, N. J.
Butterworth, I., Columbus, O.
Byers, C. A., Haverford, Pa.
Cabot, J., New York City.
Chambers, J. S., Trenton, N.J.
Chollar, B. E., St. Louis, Mo.
Clark, W., Philadelphia, Pa.
Clary, E. D., Burlington, Iowa.
Coggshall, H. F., Fitchburg, Mass.
Collins, C. R., Philadelphia, Pa.
Corbett, C. H., Brooklyn, N. Y.
Cowdery, E. G., Milwaukee, Wis.
Crafts, D. W., Northampton, Mass.
Cressler, A. D., Fort Wayne, Ind.
Croul, J., Detroit, Mich.
Crowell, F. B., New York City.
Curley, T., Wilmington, Del.
Daly, D. R., Jersey City, N. J.
Daniels, J. M., Columbia, S. C.
Davis, F. J., Waltham, Mass.
Dell, J., St. Louis, Mo.
Diall, M. N., Terre Haute, Ind.
Dickey, C. H., Baltimore, Md.
Dingee, F. A., Philadelphia, Pa.
Douglas, H. W., Ann Arbor, Mich.
Edwards, G. B., New York City.
Egner, F., Norfolk, Va.
Eilbeck, A. B., Philadelphia, Pa.
Elkins, G. W., Philadelphia, Pa.
Elkins, W. L., Jr., Phila., Pa.
Faux, J. A., Pittsburgh, Pa.
Findlay, J. H., Ogdensburg, N.Y.
Fitz, R. F., New York City.
Flemming, D. D., Jersey City, N.J.
Floyd, F. W., New York City.
Floyd, J. R., New York City.
Fodell, W. P., Philadelphia, Pa.
Forstall, A. E., Newark, N. J.
Forstall, Walton, Lockport, N.Y.
Fowler, J., Philadelphia, Pa.
Fry, C. C., Lynn, Mass.
Gandey, A. C., Lambertville, N.J.
Gardner, W., Pittsburgh, Pa.
Gartley, W. H., Philadelphia, Pa.
Gates, F. W., Hamilton, Ontario.
Geggie, D. H., Quebec, Canada.
Gerould, C. L., Mt. Vernon, N.Y.
Gibbs, W. W., Philadelphia, Pa.
Giblin, J. A., Ilion, N. Y.
Gibbons, P. H., Coatesville, Pa.
Goodwin, W. W., Phila., Pa.
Gordon, J. J., Cincinnati, O.
Greenough, M. S., Cleveland, O.
Gribbel, J., Philadelphia, Pa.
Guldlin, O. N., Fort Wayne, Ind.
Hanford, L. C., Norwalk, Conn.
Harbison, J. P., Hartford, Conn.
Harper, G. H., Altoona, Pa.
Harris, J. A., Philadelphia, Pa.
Hauk, C. D., Philadelphia, Pa.
Helme, W. E., Philadelphia, Pa.
Herron, J. T., Buffalo, N. Y.
Holzer, E. G., Roanoke, Va.
Hookey, G. S., Augusta, Ga.
Hopper, W. H., Philadelphia, Pa.
Humphreys, A. C., New York City.
Humphreys, C. J. R., Lawrence, Mass.
Humphreys, W., Waterford, N.Y.
Jenks, Z. M., Woonsocket, R. I.
Jourdan, J. H., Brooklyn, N. Y.
Kellogg, L. L., Sioux City, Iowa.
Keppelman, J. H., Reading, Pa.
Kuehn, J. L., York, Pa.
Lamson, C. D., Worcester, Mass.
Langford, J. T., Boston, Mass.
Leach, H. B., Taunton, Mass.
Learned, E. C., New Britain, Ct.
Learned, W. A., Newton, Mass.
Lillie, L. Philadelphia, Pa.
Littlehales, T., Hamilton, Ont.
Logan, W. J., Brooklyn, N. Y.
Lynch, E. T., Detroit, Mich.
Macdonald, B. J., Newburgh, N.Y.
MacDonald, W., Phila., Pa.
Mayer, F., Baltimore, Md.
McCleary, A. J., Phila., Pa.
McCullough, E. H., Phila., Pa.
McDonald, W., Albany, N. Y.
McElroy, Pittsburgh, Pa.
McIlhenny, J., Phila., Pa.
McIlhenny, J. D., Phila., Pa.
McIlhenny, J. S., Washington, D.C.
McMillin, E., New York City.
Miller, A. S., L. I. City, N. Y.
Milsted, Wm. N., New York City.
Mitchell, K. M., St. Joseph, Mo.
Morris, H. G., Phila., Pa.
Morton, F. N., Lockport, N. Y.
Neal, G. B., Boston, Mass.
Nettleton, Chas. H., Birmingham, Conn.
Newell, J. W., New Brunswick, N. J.
Nix, J. J., Royersford, Pa.
Norris, R., Phila., Pa.
Nute, J. E., Fall River, Mass.
Park, W. K., Phila., Pa.
Pearson, W. H., Jr., Toronto, Ont.
Pinkney, E. A., Utica, N. Y.
Pratt, E. G., Des Moines, Iowa.
Prichard, C. F., Lynn, Mass.
Quinn, A. K., Newport, R. I.
Ramsdell, G. G., Philadelphia, Pa.
Reilly, J. W., Wilmington, N. C.
Rice, H. L., Milwaukee, Wis.
Richardson, F. S., N. Adams, Mass.
Roberts, G. J., Philadelphia, Pa.
Rogers, W. H., Paterson, N. J.
Roots, D. T., Connersville, Ind.
Rowland, W. L., Philadelphia, Pa.
Rusby, J. M., Jersey City, N. J.
Russell, D. R., St. Louis, Mo.
Searle, R. M., Johnstown, N. Y.
Seaverns, F., New York City.
Serrill, W. J., Philadelphia, Pa.
Shelton, F. H., Philadelphia, Pa.
Sherman, F. C., New Haven, Conn.
Sisson, F. N., Albany, N. Y.
Slater, A. B., Providence, R. I.
Slater, A. B., Jr., Providence, R.I.
Smith, J. W., Phila., Pa.
Smith, M., Wilkes-Barre, Pa.
Smith, W. H., Bayonne City, N. J.
Snow, W. H., Holyoke, Mass.
Somerville, J., Indianapolis, Ind.
Spaulding, C. S., Wakefield, Mass.
Sprague, C. H., Boston, Mass.
Stacey, W., Cincinnati, O.
Stanley, I. N., Brooklyn, N.Y.
Starr, J. M., Richmond, Ind.
Steck, H., Phila., Pa.
Stirzel, J. W., Phila., Pa.
Summers, T. W., Augusta, Ga.
Thompson, G. T., St. Louis, Mo.
Thwing, O. O., Milwaukee, Wis.
Tracy, J., Poughkeepsie, N. Y.
Turner, T., Charleston, S. C.
Vanderpool, E., Newark, N. J.
Walker, J. H., Milwaukee, Wis.
Walters, A. H., Johnstown, Pa.
Ward, W. H., Easton, Pa.
Watson, C., Camden, N. J.
Weber, A., New York City.
Weber, O. B., New York City.
Wehner, A. F., New York City.
White, H. H., Portsmouth, Va.
White, W. H., New York City.
Whitney, H. C., Watertown, N. Y.
Williams, W. L., Paterson, N. J.
Williamson, J., Chicago, Ills.
Wood, W., Phila., Pa.
Young, P., Knoxville, Tenn.

Associate.

Backus, Q. S., Williamsport, Pa.
Barrows, W. E., Phila., Pa.
Coburn, C. M., Chelsea, Mass.
Collins, D. J., Phila., Pa.
Crane, W. M., New York City.
Curley, E. J., Wilmington, Del.
Field, B. K., East Berlin, Conn.
Goodwin, H. B., Phila., Pa.
Gray, J. B., Phila., Pa.
Hayward, S. F., New York City.
Higgins, C. M., New York City.
Mansur, J. H., Royersford, Pa.
Mather, H. A., Brooklyn, N. Y.
Meyer, H. H. B., New York City.
McDonald, D., Albany, N. Y.
Mordue, T. N., New York City.
Norton, H. A., Boston, Mass.
Osius, G., Detroit, Mich.
Page, A. L., New York City.
Persons, F. R., New York City.
Randolph, W. W., New York City.
Schell, E., New York City.
Starr, G. W., New Haven, Conn.
Thomas, F. W., Boston, Mass.
Townsend, W. H., New York City.
Wharton, H., Phila., Pa.
Wilbraham, J. S., Phila., Pa.
Wilson, P., Flushing, N. Y.
Whitehead, J. N., New York City.

The Recovery of Bye-Products from Producer Gas.

[By Mr. A. Gillespie, in the *Journal* of the West of Scotland Iron and Steel Institute.]

Having succeeded, to a certain extent, in the recovery of tar and ammonia from blast furnace gases, the author was invited by a glass manufacturing company to direct his attention to the possibility of obtaining like results from producer gas, and especially in connection with a series of producers developing gas for a glass bottle furnace. He was aware that attempts had been made to recover such bye-products after the gas had done its work in the melting furnace, and that these attempts had necessarily failed, for the products were never recovered, and were no doubt destroyed in the intense heat of the furnace. The question was simply whether or not the gas could be intercepted between the producer and the furnace, robbed of its tar and ammonia, and passed on to the furnace in a condition fit for its main purpose. The author gives the following account of his investigations: Two dif-

ficulties presented themselves. The temperature of the gas, as it leaves the producer, is from 800° to 1,000° F. This must be reduced to considerably less than 100° F. for the recovery of ammonia. The reduction of temperature is, therefore, in the first place, a loss of useful heat to the furnace; and, secondly, the removal of the bye-products may so reduce the potential energy as to render the gas unfit for its main purpose. The first difficulty is not a serious one, for the initial loss of temperature can be easily restored if the melting furnace is constructed on the regenerative principle. As to the second, and more serious, difficulty—the probable loss of heat energy, by the removal of the bye-products—I felt somewhat uncertain, my knowledge of the subject being mechanical rather than chemical. But if those who are familiar with the chemistry of producer gas can assure us that loss of heat by the removal of the tar compounds is not so great as to imperil the efficiency of the gas for fulfilling its chief function, I shall be satisfied if I can, with the assistance of this explanation, indicate how the bye-products can best be secured. Assuming for argument that it is only a question of proper appliances, in the right place, that is to put us in possession of profitable results, we shall endeavor to ascertain first what it is we may obtain, and then how we are going to get it. The recovery of what are termed bye-products from coal in connection with the manufacture of illuminating gas, has been in common practice for many years, though some of us can remember when they were called "nuisances," and the gas makers were at their wits' end to get rid of them. Their recovery from coal used in blast furnaces is not a matter of ancient history.

In the carbonization of the coal for illuminating purposes, there is obtained in close retorts about 10,000 cubic feet of gas per ton; and for the removal of impurities, or bye-products, the gas engineer has only to concern himself with this volume. But in the case of blast furnaces or gas producers, this volume is enormously increased by the air sent into the furnaces by the blowing engines or following the steam jets in the producer; so that, instead of 10,000 cubic feet per ton of coal, the engineer has to deal with 130,000 cubic feet, or 13 times the volume of the other. Like the search for the precious metals in quartz rock, the 10,000 cubic feet of profitable gas can only be recovered by dealing with the entire volume, which must be cooled and washed—with this difference, that, though the quartz may be of no further use, the mixture of gas and air, cleared of its tar and ammonia, is just in the right state for giving out its energy as a heating agent.

Having no immediate concern with the heating properties, let us inquire what else we may get out of this enormous body of gas. There are two main ingredients—tar and ammonia—varying in quantity according to the nature of the coal. The quantities recovered from the blast furnace gases range from about 150 to 170 pounds of tar per ton of coal, and about 5 to 6 pounds of ammonia. The tar yields by distillation about 80 to 90 pounds of pitch and and 6½ to 7½ gallons of pitch oil; while the ammoniacal liquor, when treated in the sulphate stills and saturators, is converted into from 20 to 24 pounds of sulphate per ton of coal, containing about 24 per cent. of pure ammonia. Thus, from a blast furnace consuming 75 tons of coal per 24 hours, there will be obtained about 2¼ tons of pitch, 825 gallons of oil, and 14¼ cwt. sulphate of ammonia, which, at present market rates, would yield $75. If we may take it for granted that, in the 130,000 feet of gas coming from a producer, there are the same ingredients in similar proportions to those we know are not blast furnace gas—and I am not aware that there is any essential difference in the conditions—then it becomes a question how they are to be recovered with the least possible injury to the heating energy of the gas.

This brings us to the second branch of the inquiry: How is it to be done? The dimensions of the apparatus must be regulated by the number and capacity of the producers. Upon a system of six producers, each consuming 10 tons of coal per 24 hours, the result, in proportion to what has already been stated, would be about 2¼ tons of pitch, 420 gallons of oil, and 11¼ hundred weight of sulphate of ammonia, the total value of which, at current market prices, would be about $60 per 24 hours. The main element of expense in this result is for sulphuric acid, of which 18 hundred weight are required to precipitate each ton of sulphate. Thus, $5 worth of sulphuric acid will produce 1 ton of sulphate of ammonia. The temperature of the gas will fall rapidly after leaving the producer, till it may be expected to enter the first vessel—the "tar washer," which also acts as a collecting main—at about 400° F. The gas from each producer enters the washer by a separate branch, so that each of the six may be isolated for any purpose. The gas is there broken up into thin streams by a serpentine diaphragm, with serrated edges. The lower, or serrated edge of the diaphragm is sealed in water, which is immediately displaced by the tar as it is deposited from the gas. It has been found preferable to feed the washer with tar obtained farther on in the process, with the double object of so far drying the tar by exposure with the hot gas, and at the same entangling the tarry particles from the gas as it passes through the serrations. The gas is forced in this vessel from most of the heavier tars, which fall on the sloping bottom, and are drawn off by cocks as required, and the seal kept up in the diaphragm by the addition of fresh air.

In the tar washer, the gas is reduced in temperature to about 200° F., and passes by separate branches to a collecting main of a diameter sufficient to contain the volume from the six producers, and corresponding in length to the condenser boxes. The condensers consist of a series of four boxes, made up in sections for convenience in construction; each box having 27 pairs of 8-inch diameter steel pipes, about 30 feet high. The boxes are fitted with serpentine diaphragms, serrated on the lower edge, and sealed in liquor. The gas passes from the collecting main by 27 vertical branch pipes (8-inch), which are connected at the top to the first row of condenser pipes. The gas descending to the box must pass through the sealed diaghragm before escaping up the other row of vertical pipes. In this process, the gas is washed in the cool liquid—depositing a portion of its tar and ammoniacal liquor; and the temperature is reduced by contact with the liquor and exposure to the atmosphere in the small vertical pipes.

The serpentine form of the diaphragm is adopted to increase the washing area, and enable the gas to be more thoroughly in contact with the liquor than if the mere edge of the 8-inch pipe were so sealed. The gas passes up the second row of pipes to the top—crossing then to the top of the first row of pipes in the second condenser box, where the process is repeated; then in a similar manner, passing through the third and fourth boxes, when it may be assumed that the temperature has been brought down to about 70° F. or lower, and that, in the repeated washings, the last traces of ammonia have been practically removed.

To facilitate this, and in order to strengthen the liquor as far as possible, the boxes are arranged on a graduated level; the fourth box being the highest, and the first the lowest. Clean cold water is fed continuously into the fourth box, and the level of the seal maintained at the required depth by an adjustable run-off valve and syphon, whence it is carried to the box on the next level, which is thus fed continuously with the weak liquor obtained from the fourth. The stronger liquor formed in the third is fed into the second in a similar way, and from it to the first, whence the resulting liquor is drawn off continuously for further treatment. By this process the gas becomes gradually cooler; depositing light tar, which, along with the ammonia, is carried off in the liquor, while the repeated contact with the gas in the sealed diaphragms, absorbing more ammonia in each washing, so strengthens the liquor that it is made fit for profitable treatment in the sulphate-still.

The tar and ammoniacal liquor come away together. The latter enters at the top, and spreads over the first tray to a given depth, sealing the serrated edges of the cups. The liquor overflows at the required level, and descends to the next tray; sealing the cups on it in the same way, and so down to the bottom tray. Steam at about 20 pounds pressure per square inch is introduced under the bottom tray, and immediately ascends through the nozzles, where it encounters the liquor; and it can only escape by passing a special vessel, where the products are automatically separated according to their different specific gravities, and pass into separate store tanks.

As the gas will not pass through water except under pressure corresponding to the depth of the seal, and as it is also desirable that no pressure of gas should be allowed to accumulate in the producer, it is necessary to provide mechanical means for drawing forward the gas by forming a vacuum. This is most conviently effected by an exhauster, of any of the well-known forms. One or more exhausters are placed near, and connected to, the last row of condenser pipes, and so regulated that there will be no back pressure in the producers, and just enough forward pressure on the outlet side of the exhausters to suffice for sending on the clean gas to the melting furnace. The regulation is effected by self-acting valves, which are adjusted to the required uniform pressure. The gas, now freed from the bye-products, is passed on to the melting furnace.

Our immediate interest is in what has been recovered. The tar contains a large percentage of water, which must be distilled off before the tar can be put on the market. For this purpose, the tar is forced, by a pump or an air-compressor, into an elevated tank, whence the tar gravitates into an ordinary still, which, in the case of blast furnace tar, is fired by the clean gas. The feed being shut off, the charge is evaporated, and cooled through a warm condenser. When the water has been driven off, the oil, which follows, is passed into receivers, and sold for such purposes as the Lucigen and Wells lights, oil fuel for

steamers, etc. When the oil has been run off, the residue (pitch) is passed into a cylindrical cooler, until the temperature is so far reduced that it is safe to run the pitch into open ponds, where in a few hours it hardens, and is then broken up and sold. For certain purposes, the pitch may be required of a softer consistency. This may be obtained by running it off with the oil in it. It is then sold as boiled tar. The other product—the ammoniacal liquor—after being separated from the tar, is also sent into an elevated charging tank, whence it is fed into a sulphate still. These are of various forms; but they all treat the liquor in the same manner.

The bye-products having been recovered and disposed of, there need be little anxiety as to the demand for them. Apart from the efficiency of oil as a lighting agent for a large areas, if a sufficient supply could be guaranteed, there would doubtless be a constant demand for oil as a fuel. Pitch has maintained a ready sale; while the use of sulphate of ammonia as a fertilizer gains daily in favor.

Hefner and Pentane Standard Lamps and the Conditions of the Atmosphere.

The *Gas World* says that Dr. Liebenthal, of the Imperial Physical Technical Institute, Charlottenburg, reports that that Institution has been at work investigating the variations of Hefner (amyl acetate) standard lamps and pentane standard lamps with variations in the condition of the surrounding air.

Hefner (Amyl-Acetate) Lamps.

1. *Moisture.*—The variations are more considerable than had at first been expected. The lamp is brighter in winter than in summer; from June to September it is about 2 per cent. too low, and from December to February about 2 per cent. too high. Besides, there are continual fluctuations. It was found that the standard unit was reached when the composition of the air corresponded to 10,000 liters of dry air plus 88 liters of water vapor; and that the light was regularly increased or diminished by 0.00055 for each liter of water vapor per 10,000 in excess of or below this. The official standardizing at Charlottenburg now takes this into account. Another formula, more useful for practical purposes, is: Suppose that at a given temperature the air is charged with moisture to the amount of h per cent., that is, h per cent. of the amount which would correspond to complete saturation at that temperature, the humidity, expressed in percentages, is, then, h. This being so, the lighting power of the Hefner lamp is, in corrected Hefner units, $1.050 - 0.001905\ p\ h$, where p is the vapor pressure (in inches of mercury) of the fully saturated vapor of water at that temperature. For example, to take an extreme case, let the temperature be 26° C. (78.8° F.), at that temperature the pressure p of water vapor is, in round numbers, 1 inch of mercury; if the humidity be $h = 90$ per cent., the formula works out the value of the lighting power of the lamp as 0.881 corrected Hefner units; and all photometric measurements would have to be amended accordingly. But in measuring the percentage humidity h, it has to be noticed that if the hair-hygrometer be used the following amendments have to be made: If the instrument reads 40 per cent. we must take this as a reading of 17; if 45, 23; if 50, 29; if 55, 35; if 60, 41; if 65, 47; if 70, 52; if 75, 58; if 80, 63; if 85, 68 per cent. These corrections apply only to the rough-and-ready hair-hygrometer, and not to systematic work with a dry and wet bulb and a set of tables, which give the true value of the humidity h.

Pressure of the Atmosphere.—Between 29 and 31 inches of mercury the variations due to this are very small. Each 1-25th of an inch above 29.92 inches of mercury causes a gain of lighting power equal to 0.00011 unit; and each 1-25th below that reduces it to the same extent.

Carbonic Acid.—If x liters of carbonic acid be added to 10,000 liters of dry air the lamp has its lighting power between 6 and 13.7 parts to 10,000, diminished by $0.00072\ x$, or $0.07\ x$ per cent. Thus, if the air in the photometer room has a carbonic acid content corresponding to 9 parts per 10,000, the lamp gives 0.63 per cent. less light. In a well-ventilated room, where the carbonic acid is about 3 parts per 10,000, the fall in light due to this cause is about 0.2 per cent.

Oxygen.—Let the oxygen fall by 1-10 per cent. by volume, that is, from 20.9 to 20.8, then the fall in the lighting power is from 1 to 0.979 corrected Hefner units; a drop of 2.1 per cent.

These considerations point out the necessity of a large and well ventilated photometer room.

The Pentane Lamp.

The lamp used was the latest model, from Woodhouse & Rawson, of 1-candle power.

When the flame rises so that its tip first corresponds to and then surmounts the limit fixed for it, the brightness of the lamp varies in the ratios of 97.9, 99.5, 100, 99.5, 97.5, according as the tip reaches the bottom of the top sights, or fills ¼, ½, ¾, or the whole of them. The least variations in lighting power are thus observed when the tip of the flame is adjusted so as to come up to the middle of the sights.

As the lamp warms the flame grows taller, and if the wick be not continuously turned down the lighting power goes up 15 per cent. or more. This goes on until thermal equilibrium is attained, which takes some 30 minutes; a much longer time than the amyl-acetate lamp takes.

The pentane lamp of 1 candle was found to have an average lighting power of 1.17 Hefner unit, or 1.026 English candle; the English candle being 1.14 Hefner unit.

At different distances differently sized areas of the flame are in view, and this causes errors. The inner radius of the screening tube being r, and the distance between the axis of the flame and the screen being d, the squared divisor should be neither d nor the distance between screen and lamp, but $\left(d - \frac{r}{2}\right)$. This keeps matters straight in this respect.

Moisture.—To 10,000 parts of dry air by volume add x of water vapor; then the lighting power of the pentane lamp is (for values of x between 40 and 180) equal to $1.232\ (1 - 0.00055\ x)$; but the law is more irregularly obeyed than the corresponding law for the Hefner lamp; the data obtained do not plot out nearly so well in a curve.

Barometric Pressure.—Every twenty-fifth of an inch rise or fall from 29.92 inches of mercury causes a rise or fall in lighting power of 0.0005, or $\frac{1}{20}$ per cent. This is nearly five times as great as with the Hefner; and with the pentane lamp the height above sea level becomes of importance.

Aluminum Solders.

In the course of a paper on this topic, read by Mr. Joseph Richards before the Franklin Institute, the author said that very soon after Deville first made aluminum on a large scale it was found that it was a most difficult problem to solder it satisfactorily. The ordinary alloys used for soldering were found not to attach themselves to aluminum despite every usual precaution, and it was seen that unusual solders must be devised to meet this unusual problem. M. Christofle, the goldsmith of Paris, gave the subject his special attention, and discovered that aluminum was wetted by, and could therefore be soldered with, either pure zinc or pure tin. It is indeed true that both of these metals hold firmly to the aluminum, but the zinc seam is brittle and crystalline, will not stand working, and discolors badly in a short time, while the tin seam has the disadvantage of disintegrating and falling to pieces in a few weeks. This latter phenomenon is due to the fact that certain alloys of tin and aluminum will decompose spontaneously by the action of the air. This is particularly true of tin containing small proportions of aluminum, up to 10 per cent.; for, if a bar of such alloy is left in the air, and portions are broken off at regular intervals, a change will be visible in the section, proceeding from the outside toward the center; and while at first the alloy is strong and tough, it gradually becomes more and more friable, until at length, when the change has reached the center, it breaks like a pipe stem. I have observed a bar $\frac{1}{16}$-inch thick to become decomposed all through in three weeks, and on thinner sections the effect is still more marked. Tin containing 0.5 per cent. of aluminum was rolled by a Philadelphia maker of tin foil into foil 0.001-inch thick, and, while it rolled beautifully, yet in two hours thereafter the whole sheet was as brittle as glass. Now, bearing these facts in mind, it can easily be understood why a joint soldered with tin falls apart. The tin attaches itself to the aluminum by forming an alloy at the junction, and this alloy decomposes in a short time.

It would be a serious task to catalogue all the different metallic mixtures which have been proposed for soldering aluminum since M. Christofle's experiments in 1855. Alloys of aluminum and zinc were tried by the Tissier Bros., but were found to be too brittle. M. Hulot proposed to first plate the aluminum at the joint with copper and to solder the coppered surfaces with ordinary solder.

At length the Société d'Encouragement offered a prize for the solution of this problem, which was awarded to Mourey, a Parisian goldsmith. His best solders were alloys of aluminum and zinc, to which small proportions of copper were added to give them toughness. The chief difficulty with these solders is their high melting point; the zinc, which melts only at incipient red heat, being the most easily fusible ingredient. For brazing and blowpipe work such high melting alloys can be used, and the addition of a little silver improves them still more; but none of them can be regarded as convenient for use with the soldering iron.

It has been claimed that by using silver chloride as a flux, aluminum can be soldered in the ordinary way with ordinary tin solder, but this method has not proved satisfactory in practice, and, even if it were, the flux is too expensive.

Starting with a full understanding of the difficulties of the problem, and a knowledge of what had been previously tried and found wanting, I proceeded with the object of finding, if possible, a solder which should have the following qualifications:

1. It must wet the aluminum and adhere firmly.
2. It must not disintegrate after exposure to the air.
3. It must be as malleable and strong as aluminum.
4. It must have a low melting point, so as to be easily worked with a soldering iron.
5. It must have the same color as aluminum and not change color; and
6. It must be cheap enough for general use.

After experimenting about two years it was finally found that an alloy of zinc and tin in certain proportions containing a little aluminum and some *phosphorus*, realized almost every qualification. The alloy used for some time was made by fusing together:

	Parts.
Aluminum	1
Ten per cent. phosphor tin	1
Zinc	8
Tin	32

It was found, however, that on remelting this solder a more fusible alloy liquated away from it. It appeared reasonable to assume that this more fusible part was a true alloy of zinc and tin, and therefore a more stable compound. This fusible portion was also found to solder better than the original mixture. This liquated solder was therefore analyzed, with the result that its composition was found to be very close to that expressed by the formula Sn_4Zn_3. The solder which I now use is made to correspond closely to this formula. It is obtained by using the ingredients in the proportions 1, 1, 11, 29, instead of 1, 1, 8, 32, as previously described. The percentage composition of the several alloys described may be thus compared:

	Original Solder.	Found in the Liquated Alloy.	The Formula Sn_4Zn_3 Calls for—	Solder, as Now Made, Contains—
Aluminum...	2.38	.....	....	2.38 } Zinc + aluminum
Zinc.....	19.04	.....	29.3	26.19 } 28.57 per cent.
Tin.....	78.34	71.65	70.7	71.19
Phosphorus..	0.24	.....	....	0.24

The percentage of zinc in the new solder is lower than called for by the formula Sn_4Zn_3; but since aluminum and zinc are metals having many physical analogies, it was thought advisable to bring the combined percentage of these up to that required for the zinc alone. Further, as the tin is most liable to lose by oxidation during the mixing of the solder, it was thought best to have it slightly in excess. As practical usefulness is a fair criterion of the value of an invention, I may be permitted to mention that this solder has come largely into use in Germany, Switzerland, England and our own country.

It must be remembered that at present the demand for an aluminum solder is limited. About 4 tons of aluminum are now produced daily in the world, but fully 75 per cent. of this is used up in the steel industry and in making alloys; while of the remaining 25 per cent. which is rolled, spun, cast or stamped into pure aluminum articles probably not 10 per cent. is in such shape as to require soldering. Assuming, then, an average of 200 pounds a day of aluminum articles to be soldered, a daily supply of a very few pounds of solder would meet the entire demand. It does not require the prophetic eye, however, to see that the 1,000 tons of aluminum produced during 1893 will probaby reach 10,000 tons a year within the next 10 years, and that with increased production the demand for a good solder must correspondingly increase.

Electricity and the Proposed International Exhibition at Paris.

Mr. Dumont, in a communication printed in the *Journal* of the French Society of Civil Engineers, details the things electrical seen and shown at the Paris Exhibition of 1889; at Chicago, in 1893; and at Lyons, in 1894. Basing their operations upon the experience gained at these exhibitions, the directors of the Paris Exhibition of 1900 have outlined their plans in a bulletin issued a short time ago. In reference to this matter Mr. Dumont says that it appears, then, that, thanks to the precedents thus established and the degree of perfection attained in the construction of dynamos and motors, that it is absolutely the proper thing to do to have recourse to electricity in 1900 for the complete organization of a service that shall include the lighting and distribution of power to the exhibitors. In a general way it is understood that this double service will include several central generating stations, which shall themselves be exhibitions of boilers, steam engines, and dynamos. Some will be devoted to the production of a continuous current, and others to the alternating current. From these generating stations the conductors are to run out either underground or overhead for the distribution of the necessary lighting or power current. The public will thus be in a position to arrive at the exact value of the different systems that are in use.

It is expected that the total amount of power required in 1900 for these several systems will be about 8,000-horse power for motors and 12,000-horse power for lighting. It is further expected that in the evening the stations will be called upon to supply the full quota of light and about one-quarter of the motors that are installed.

Adopting the ratio of efficiency of 70 per cent., as given by the Lyons installation, for the power absorbed by the motors, the mechanical power required for the work will be $8,000 \div .70 = 11,400$ horse power for the distribution of power instead of the 5,500 horse power used for this purpose in 1889; and $12,000 \div .70 = 17,100$ horse power for the lighting circuits instead of the 4,000 horse power required in 1889 to light one-quarter only of the area of the exposition grounds. This gives a total of 28,500 horse power that will be required if all of the lamps and motors are working together.

Practically (unless accumulators are used) the machines ought to furnish 11,400 horse power to the motors during the day, and in the evening, from 7 o'clock till midnight, 2,900 horse power to the motors and 17,100 to the lamps, or a total of 20,000 horse power.

In this case it is proposed that the generating plants should consist of 40 units of 500 horse power each, of which one-half shall be at rest during the day, thus leaving a machine at rest on exhibition by the side of its duplicate which is in motion. By the use of accumulators it would be possible to install a smaller number of units which would develop their full power from early morning until the closing of the gates, say from about 9 o'clock until midnight. Under these circumstances the engines would supply the power required for driving the motors and charging the accumulators between the hours of 9 and 7; while in the evening the engines and accumulators would supply the 20,000 horse power indicated.

A calculation of the expense of installation of the two systems has shown them to be about the same, but with a slight difference in favor of the use of accumulators; but if accumulators are useful in a plant containing only a small number of motors, because the power is very irregular, they will hardly be justified in an exposition which will include a large number of motors, each representing only a very small percentage of the total power. Furthermore, the consumption of coal will be less if engines are exclusively used, since 11,400 horse power will have to be furnished during the day for 10 hours, 20,000 during the evening for five hours, making a total of 214,000 horse power hours, while with the accumulators 225,000 horse power hours will be required.

But if it is finally decided that it is not advisable to use accumulators in the production of the energy required in the general system of distribution, they will be valuable for exhibitors who can charge batteries by connecting them to the main lines leading to the lamps and motors. They can then be discharged at will by the exhibitor, for whom they will constitute a sort of reservoir of electricity. It will be with the aid of these accumulators that will form, as it were, sub stations, that experiments of the greatest interest can be made in view of the visitors, showing the various uses to which accumulators can be put, the method of charging and discharging, making connections, etc., and at the same time permitting them to ascertain the space required and the method of installation for each type.

We have already said that the central electric stations will be made interesting exhibits of boilers, steam engines, gas engines, etc. The value of these exhibits will be increased by the fact that it will be possible to make a comparison of the conditions of installation, running efficiency of engines and gas engines.

It is, therefore, expected that the central stations will be equipped by exhibitors, and that they will furnish the current required to the exhibition; that the management of the exhibition will construct the system of wiring for the distribution of the current; that the electricity thus made available will be sold to the contractors who assume the responsibility of distributing it to individual exhibitors for lighting and to supply the lamps used for general illumination; that the location and wiring of the motors required by the exhibitors will be undertaken by the contractors, who will have the concession for supplying the current needed by the exhibitors for the operation of their motors.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. SAMUEL MORRIS, of Troy, N. Y., who hopes to succeed Mr. Clinchy, of this city, in the comfortable berth of Chief of the State Board of Gas Meter Inspectors, is uneasily moving around Albany, anxiously inquiring why Governor Morton does not order the dismissal forthwith of the present incumbent. Well informed Albanians assert that no change will be made until the laws governing gas meter inspection in this State are amended materially during the next session of the Legislature.

MR. GEORGE H. HARPER, the clever Superintendent of the Altoona (Pa.) Gas Company, is responsible for the following advertisement which appears from time to time in the reading notices of the local newspapers:

"At this season of the year there is a liability to have trouble with the gas arising from sudden cold causing a deposit of matter in the house and service pipes. The Company desires to impress upon its patrons that the trouble is an entirely local one, and easily remedied. Do not ask on the street corners, 'What is the matter with the gas?' but make your complaint direct to the Company's office, 1110 Eleventh street, when prompt attention will be given to it. Remember, it is not for the gas company's interest that you should have poor service, and it respectfully asks to be made aware of such."

THE offices of the Bridgeport (Conn.) Gas Light Company have been removed to spacious rooms in No. 31 John street, which puts the Company in better touch with the business center of the city.

The manufacture of gas at the plant of the Citizen's Gas Company, Terre Haute, Ind., has been discontinued, but the holder station there will be maintained.

ACCORDING to the Peoria (Ills.) *Journal*, J. Frank Aldrich, the party who induced the Peoria City Council to grant himself and associates a franchise for an opposition gas works in that city, has notified the Council of his purpose to "relinquish and surrender" the rights granted him for furnishing gas and electric light. He explained his change of base by stating that he was disappointed in securing an electric light contract with the city and "in obtaining contracts with private consumers to use the gas he proposed to supply."

THE Modesto (Cal.) Electric Light Company has gone out of business, and Mr. Frank A. Cressey, of the Modesto Gas Light, Coal and Coke Company, has notified the gas consumers that hereafter they will be obliged to pay $4 per 1,000 cubic feet. This means the cutting off of the discount of 25 per cent. for prompt payment that ruled during the competition with the electric light suppliers. Although the rate seems high, all things taken into consideration, it is in reality equal to about a rate of $2 per 1,000, say, for instance, in a town of equal population (2,600) in Central New York.

MR. BATCHELOR, into whose hands the management of the Ellenville (N. Y.) Gas Company has passed, intends, it is said, to put the property in something like working order.

THE coal gas addition to the plant of the Clinton (Iowa) Gas Light and Coke Company is in action. Furthermore, it is giving good satisfaction to Mr. Highlands. The Company has fixed upon $3 per short ton as the selling price for coke.

THE Central Oil Gas Stove Company, with plants in Florence and Gardner, Mass., Greenwich, Conn., and Jackson, Mich., has assigned to Messrs. M. F. Dickinson, of Boston, Charles W. Conant, of Gardner, and C. H. Hill, of Chicago. The liabilities are put at $500,000, with nominal assets of like amount.

THE offices of the Toledo (Ohio) Gas Light and Coke Company are to be located in the Valentine building.

THE proprietors of the Standard Gas and Electric Light Company, of Huntington, L. I., offer to run service pipes free of charge to intending consumers of gas. The Company's Superintendent is Mr. J. N. Dickerson.

THE Berlin Iron Bridge Company, of East Berlin, Conn., has just completed, for the Somerville Woolen Mills, at Somerville, N. J., a spinning room, 54 feet wide and 210 feet long, and a boiler room, 40 feet wide and 216 feet long. The construction of the spinning room is of steel trusses, with heavy plank floors and roof. The boiler room is constructed with brick walls, steel trusses and corrugated steel covering, making it absolutely fireproof.

WE are indebted to Mr. F. A. Sabbaton, Jr., Superintendent of the Glens Falls (N. Y.) Gas Light Company, for the following interesting note:

THE GLENS FALLS GAS LIGHT COMPANY,
GLENS FALLS, N. Y., Nov. 11th, 1895.

To the Editor AMERICAN GAS LIGHT JOURNAL: At a special term of the Circuit Court, held in Glens Falls, beginning October 21st, a hearing was had before Justice J. S. Landon, of Schenectady, in the cases of the Glens Falls Gas Light Company against the village of Glens Falls, and against Van Vranken & Deull, sewer contractors, brought to recover damages sustained by the Gas Company, in the years 1893 and 1894, during the construction of the sewer system in the said village. Witnesses for the Gas Company testified that the mains and service pipes of the Company had been broken and removed from the ground, when, if proper methods for protection had been used, this would not have been necessary. They allege to have been damaged to an amount in the neighborhood of $4,500 for replacing the broken pipes and for leakage of gas caused by these breaks. The hearing was continued for several days, and at the conclusion of the testimony Justice Landon gave the attorneys 30 days in which to submit their briefs. His decision will be handed in at the expiration of this period. Truly yours, F. A. SABBATON, JR.

A VERY interesting and successful trial of the Bader patent smoke protector was made, on the afternoon of the 12th inst., at the Brooklyn Navy Yard. The apparatus, which is intended to protect those whose duties require them to work occasionally, or oftener, in a noxious or flame and smoke laden atmosphere, seems to us to have positive merit, and so is worthy the examination of gas men. Mr. S. F. Hayward, of iron sponge and governor fame, of this city, will gladly furnish detailed information respecting the apparatus.

THE organization of the Mt. Clemens (Mich.) Gas Company has been formally perfected. The officers chosen are: President, Joseph M. Uplegar; Vice-President, Joseph Holman; Secretary, M. M. Smith; Treasurer, W. H. Morgans.

SOME time ago the proprietors of the Saratoga Springs (N. Y.) Gas and Electric Light Company were informed, through the local public prints, that they had been using water on their works for which no return was made to the Water Board. The Company insisted on an investigation by the authorities, and the Water Board accordingly appointed a committee to look into the charges. The report of the committee was to the effect that "Nothing was found to confirm the complaint."

THE Hartford (Conn.) Water Board is also likely to hear in no uncertain way from President Howard and Manager Harbison, of the Hartford City Gas Light Company, in respect of a charge not unlike that above reported. Partisanship and rotten politics are, of course, not held to accountability for some of the charges that emanate from such sources; but when men of the stamp and caliber of ex-Governor Howard, John P. Harbison and their associates in the Hartford City Gas Company are charged with being stealers of city water, it is time that partisanship and rotten politics should be brought up with a round turn.

HELENA POWER AND LIGHT COMPANY,
HELENA, MONTANA, Nov. 8, 1895.

To the Editor AMERICAN GAS LIGHT JOURNAL:—I am surprised that your JOURNAL has so long ignored what the public consider a formidable competitor in the near future of coal and water gas and electric light. Parties in our city have paid $50,000 for the State right to make acetylene gas in Montana. Will you not collect data and publish the same, giving in detail cost of manufacture and your opinion as to its future commercial success. Are the processes of manufacture patented? If so, who are the promoters of the scheme for selling State rights? Is it true that it is in practical use in Philadelphia? Your prompt attention will be appreciated.—Yours truly, H. M. PACHEN, Pres.

[WE submit that inquiries of this sort are rather disheartening. The Helena Company, of which Mr. Pachen is President, has been for years and is now on our subscription list; yet from the tenor of his letter one would infer that the JOURNAL has had nothing to say upon the subject of acetylene. The fact is, however, that no other paper in the world has kept fairer and closer record of carbide of calcium and the gaseous product resultant therefrom than has the AMERICAN GAS LIGHT JOURNAL. For Mr. Pachen's aid we herewith compile the JOURNAL'S record in this respect, noting the issues in which references to the matter in hand appear: Dec. 24, 1894, pp. 903-04-05-06. Feb. 4, 1895, pp. 146-7-8-9.

Feb. 11, 1895, pp. 182-3-4; also, editorial reference, same issue, p. 182. Feb. 25th, pp. 260-61; same issue, p. 263. March 11th, pp. 326-27; p. 337. March 25th, pp. 402-3-4; pp. 407-8. April 1, pp. 442-3-4-5 449-50-51. April 8, p. 492, pp. 528-9. April 29, p. 613. June 3, pp. 802-03-04. June 17th, pp. 885-6-7. July 1, p. 20. July 8, pp. 42-3-4-5-6; p. 49. July 15, pp. 81-2-3; pp. 89-90-91. Aug. 12, pp. 252-3. Oct. 14, p. 618. Nov. 11, p. 770-71-72.—EDS.]

THE following letter is referred to the makers of capital on the acetylene basis for consideration:

OFFICE OF AUBURN GAS LIGHT COMPANY,
AUBURN, N. Y., Nov. 12, 1895.

To the Editor AMERICAN GAS LIGHT JOURNAL: I have been very much interested in reading, in your issue for November 11th, your report of Mr. Goodwin's lecture before the American Gas Light Association, on the subject of acetylene gas at the recent Philadelphia meeting, especially the closing remarks of the same, to the effect that the carbide can be produced for "$20 per ton." And, then, "As one ton of 2,000 pounds of carbide of calcium will produce about 11,000 cubic feet of acetylene gas capable of supplying 22,000 ½-foot burners, each of which will give a light equal to 25 standard sperm candles for one hour, or an aggregate of 550,000 standard sperm candles, compare this with the number of 5-foot burners that the gas from 1 ton of coal will supply for the same time, then aggregate the total candle power of same, a calculation which you can all make and which I omit for reasons." Wouldn't the comparison be a better comparison if made with $20 worth of coal, instead of one ton of coal? And why does he compare with a 5 foot burner? If he is going in for the latest up-to-date inventions, then it is only fair to use the Welsbach burner, which is rapidly becoming the common burner for practical purposes. In the Company which I represent, the net cost of coal—that is, the cost of coal less the avails from residuals—is something less than $1 per ton, and that is probably a fair average price for companies within 500 miles of coal mines. Now, let us make a comparison that is a comparison. Twenty dollars' worth of carbide of calcium, or 2,000 lbs., will produce 11,000 cubic feet of acetylene gas, supplying 22,000 burners of one-half foot each, and of 25-candle power each, or 550,000 standard sperm candles. Twenty dollars' worth of coal—net cost of 20 tons, or 40,000 lbs.—will produce 200,000 cubic feet of coal gas, supplying 66,666 Welsbach burners of 3 feet each, and of 40 to 60-candle power each, say, an average of 50-candle power, would give 3,333,000 standard sperm candles—a showing of more than 6 to 1 in favor of coal gas and Welsbach burners. I am well aware that the above figures on the cost of coal gas will be subject to serious attack from various quarters, but I claim that they are just as invulnerable as any figures or statements yet produced in regard to the cost of acetylene gas; and they are furnished without charge for the respectful consideration of would-be investors in acetylene gas projects.—D. M. DUNNING.

THE proprietors of the Peoples Light and Power Company, of Danielsonville, Ct., have notified the gas consumers of that place of an increase in the gas rate, the same to date from the 1st inst. The increase is equal to 50 cents per 1,000 cubic feet, and the Company states that the reason for its action is the great advance in the price it has to pay for naphtha.

ACCORDING to the estimate of Mr. Henry Hopkins, City Lamp Inspector, New Haven, Conn., the public lighting of that city for 1896 will call for the following expenditure: Arc lamps, No. lamps, 434, cost, $47,523; gas lamps, 783, cost, $18,000; naphtha lamps, 440, cost, $12,000; lighting public buildings, $2,500. The Inspector also advises the trial of Welsbach burners for street lighting purposes.

THE Easthampton (Mass.) Gas Company has notified its patrons of a reduction in the gas rate, which amounts virtually to a concession of 50 cents per 1,000 cubic feet.

WE understand that control of the Norwich City (Conn.) Gas Company is likely to pass into new hands, a syndicate having offered $150 per share for the stock, the present holders to have the right to divide the surplus in the Company's treasury, which is equivalent to a dividend of 25 per cent. The Directors of the Company have assented to the proposition, and possibly three-quarters of the stockholders have also signified their willingness to accept the offer.

THE following respecting the consolidation in Brooklyn, N. Y., is from the Brooklyn *Eagle*, dated Sunday, November 10th:

All last Monday the stockholders of the several local Gas Companies voted on the proposition of the Brooklyn Union Gas Company to sell out their interests and be consolidated under the management of the one Company. The propositions which were made to the stockholders met with their approval with scarcely an exception of any importance, and in each Company the vote was so large in favor of consolidation that it might be called unanimous. The Brooklyn Union Gas Company was organized on September 8, with a capital of $15,000,000 in stock and an equal amount of bonds. It was known at the time that the bonds of the Company were all printed and that everything was apparently ready to be submitted to the several Companies for their vote, but there came a little hitch in the plans which delayed matters until the latter part of October, when the propositions were made and the meetings of the stockholders of the Companies were called. The propositions which were made were for an exchange of the stock of the old Companies for securities in the new. The following table shows the value at par of the Brooklyn Union securities to be exchanged for each share of the old stock in each of the Companies:

	Bonds.	Stocks.
Brooklyn	22.75	24.37½
Metropolitan	132.13	172.41
Fulton-Municipal	112.38	135.71
Citizens	8.57	85.71
Williamsburgh	97.00	157.50
Nassau	46.80	63.00
Peoples	3.40	9.00

In the following table is shown the present capital of each of the old Companies and the total stocks and bonds which will be exchanged for those securities. It shows that the Nassau receives the most, securing at par $5,490,000 stocks and bonds. It will be interesting to note that the total amount of stock of the new Company used in securing the old stock is $14,213,000, leaving $787,000 of the new stock presumably in the treasury of the Company. Of that amount, however, it is said that there is a syndicate composed of people whose identity is kept a profound secret to whom will be given a certain amount of the stock as a commission for their efforts in bringing about the consolidation. Of the new bonds $10,120,000 will be used in exchange for old stock. The remainder will be used in taking up the $3,282,000 bonds and certificates which are now outstanding of the old Gas Companies and in making improvements to the plants.

	Capital.	New Stock.	New Bonds.
Brooklyn	$2,000,000	$1,950,000	$1,820,000
Metropolitan	870,000	1,399,967	1,148,865
Fulton-Municipal	2,100,000	2,848,910	2,359,980
Citizens	2,000,000	1,714,200	171,400
Williamsburgh	1,000,000	2,150,000	1,940,000
Nassau	1,250,000	3,150,000	2,340,000
People's	1,000,000	900,000	340,000
Total	$10,220,000	$14,213,077	$10,120,245

It is not the intention of the new Company to make any immediate changes in the personnel of the management of the several companies. Last week there was a meeting at the office of the Brooklyn Company, in Remsen street, of the Secretaries of the several Companies, and they were carefully questioned regarding the financial policy and management of the Companies they represented. The second floor of the Brooklyn Company, which has never been put to any practical use, is to be fitted up as the office of the Brooklyn Union Company, and the other offices are to be termed branches. General Jourdan said that it would scarcely be practicable to make any important changes in the methods of manufacture until next spring, when the output would decrease. It is likely, he said, that only three plants will be used—the Fulton-Municipal, the Nassau and the Williamsburgh. They are selected because of their excellent situation. In time their plants will be enlarged, so that any two of them will be equal to supplying the entire demand. There will, of course, be many economies possible in the making of gas when one large Company is enabled to make contracts for supplies which heretofore have been made by seven small ones. There will also be economies in the number of employees, in the number of executive officers and in the number of plants which will have to be kept up. This will decrease the operating expenses, while the income will be increased by the rentals from unused properties and the selling of useless real estate and from an increased output which can now be secured by active canvassing. Before the gas fight of two years ago began the amount of money paid out in dividends by the seven Companies aggregated a little less than $540,000. There is no way of getting at the exact net earnings of the Companies, but one of them was earning nearly four times the amount it paid out in dividends, and

(*Continued on page* 822.)

THE AMERICAN GAS LIGHT JOURNAL

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(*Continued from page* 821.)

two of them were earning three times their dividends. Whether the new Company can pay its fixed charges and a dividend beside on a capital stock half as large again and a bonded debt almost three times as large, is a question for prophets to labor over. In an interview, E. R. Chapman, Treasurer of the new Company, says: "The assertion that the Standard Oil Company is interested in the new Company is without foundation, although two or three gentlemen associated with the Standard Oil Company were stockholders in some of the Brooklyn Gas Companies and have received the same proportion of the securities of the new Company as other stockholders." One thing which has caused considerable comment is the fact that Charles H. Stoddard, ex-President of the Metropolitan Gas Company, has been made Assistant Treasurer of the new Company, a place which is considered one of the best plums there was to be plucked. It has caused comment for this reason: About three years ago Mr. Stoddard was the direct cause of having dropped from the Board of Directors of the Metropolitan Company several of those men who were associated with the Standard Oil Company. Then he had the works of the Metropolitan Company put in good condition and refused to permit the Fulton Municipal Company to supply it with gas, as the Fulton Company had been doing since the first great gas war 10 years before. That was the first note of war in the fight which was carried on up to a year ago. Since then Mr. Stoddard has been elected to fill a Vice-Presidency, and now he is chosen to fill a prominent office by the people he turned out. The property of several of the old Companies has already been transferred to the Brooklyn Union Company. It is not generally expected that the new securities will be issued for the old stock until after December 1.

New Method of Refrigeration.

Considerable advances have taken place in the last few years of the processes adopted for artificially producing low temperatures, and, as the reports of the various experiments made by Professor Dewar at the Royal Institution have shown, degrees of cold can now be obtained with a facility which a few years ago would have been thought impossible, and such permanent gases as oxygen, nitrogen and hydrogen are liquefied without difficulty. Hitherto the necessary reduction of temperature to the critical point of such a gas, or rather a mixture of gases, such as is contained in the atmosphere, has been effected by the successive employment of liquefied gases boiling at lower and lower points on the scale, the latent heat of evaporation being employed as the medium for abstracting heat from the gas experimented upon, the final decrement of heat being obtained by the rapid evaporation of the liquid product itself.

By a new process, however, the laboratory methods that have so far been employed for the liquefaction of gases having a very low boiling point appear likely to be supplemented, at all events, in producing such products on a commercial scale. The process, which is the invention of Herr Linde, a man of experience in refrigerating machinery methods, has been described in a recent issue of the London *Times*. The new apparatus dispenses with the use of intermediate cooling agents, and relies entirely upon initial compression by powerful engines and subsequent partial expansion of the compressed air under carefully regulated conditions.

Most people probably have seen at one time or another the familiar lecture room experiment of forcing a piston suddenly down a cylinder, and showing the ignition of a scrap of touch paper by the heat thus produced. If while the compression is maintained the cylinder and its contained air be cooled to the original temperature, then, on suddenly withdrawing the piston and allowing the air to regain its original volume, there will be a fall of temperature corresponding to the rise on compression.

If now the cooled air could be used to reduce the temperature of a second quantity of air before expansion, it is evident that, starting from a lower point than the first batch, the second would, on expansion, reach a lower point.

This is the principle of the new liquid air apparatus. A powerful engine compresses air, which is cooled as far as possible by ordinary refrigerating methods, and passed into a spirally coiled pipe, over 100 yards long. This pipe is inclosed in a second spiral. By means of a valve at the end of the inner spiral a certain proportion of the compressed air is allowed to expand in the space between it and the outer pipe. Thus the stream of air flowing to and also from the pump is cooled by the compressed portion which has been allowed to expand, and arrives in its turn at the valve in a colder state than the portion that preceded it. Consequently it reaches a still lower temperature on expansion, cooling yet more powerfully the advancing stream in the inner tube.

By carrying this cumulative cooling effect sufficiently far the circulating air is at last brought down to its critical point, and liquefies, after which a continuous stream of liquid air is merely a question of engine power. It is impossible without the aid of diagrams to explain clearly how the continuity of the process is maintained, but the cycle of operations can be readily apprehended. There is compression, expansion in a closed chamber, and utilization of the cold thus produced to repeat the cycle from a lower initial temperature.

During the process just described the air becomes steadily richer in oxygen until that gas forms some 70 per cent. of the product. This relatively pure oxygen is sufficiently good for certain purposes, and it may be further purified from nitrogen if desired. The price of oxygen gas thus obtained compares, it is said, favorably with that produced by the methods now in use. It would have been gratifying (the *Times* remarks) to have been able to announce that this commercial application of recent scientific ideas, so closely associated with the Royal Institution, had been made in England. But, unfortunately, in this, as in so many other cases, it has been "made in Germany," where there is at present far more alertness and a far higher standard of technical knowledge than among ourselves.

Pennsylvania Coal Production in 1894.

The *Am. Mfr.* says the forthcoming report of the Department of the Interior will show that the aggregate production of coal in Pennsylvania for 1894 was 85,306,389 tons, a decrease of 5,295,072 tons from the production of 1893. This decrease was caused partly by the business depression and partly by a strike in the bituminous region that was in progress from April until August. The production of anthracite coal was 45,506,179 tons, as against 47,179,563 tons in 1893, a reduction of 1,673,384 tons. The bituminous production was 39,800,210 tons, as against 43,421,989 tons in 1893, a reduction of 3,621,170 tons. While the production shows this great falling off, the total number of employees in and about the mines has increased. The number employed during 1894 was 226,872, as against 219,821 in 1893, an increase of 7,051. This seeming incongruity can best be explained by the reduced number of days the mines were in operation during 1894. In the bituminous regions, where a strike was in progress for several months, and where the general depression in all kinds of business caused a diminution in the coal production of 3,621,688 tons as compared with 1893, the hard times were felt to a greater degree than in the anthracite regions.

Visible Radiation and Temperature.

A new determination of the lowest temperature at which a hot body becomes visible is published by Mgr. Pettinnelli, in the *Nuovo Cimento*. He heated a cast iron cylinder 30 cm. long and 14 cm. broad, in a wrought iron jacket over a Bunsen burner, to a temperature of 460° C., as indicated by an air thermometer, and then observed its flat end in a dark room from a point 60 cm. above it. When it had cooled to about 415° the red heat vanished and gave away to an indefinite hazy glow. This glow completely disappeared at 404°, and repeated observations gave an error of only 3°.

Highly emissive substances, such as the "mantles" made by Auer and others for incandescent gas lighting, became visible at the same temperature; but reflecting surfaces had

to be heated 20° higher before they appeared to the eye, and glass still more. These low temperature rays were found to traverse glass and water like ordinary light rays, but they suffer a comparatively greater absorption. Different eyes differ slightly in their capacity for seeing them, the maximum divergence being about 6°. But then the extent of surface must be the same. Mgr. Pettinelli found that if he screened off all but $\frac{1}{19}$th of the surface the body had to be heated 6° higher than before to become visible.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 Wall St., New York City.

November 18.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	149	149½
Central	500,000	50	150	..
" Scrip	220,000	..	100	..
Equitable	4,000,000	100	199	202
Bonds, 6's	1,000,000	1,000	106	..
" 1st Con. 5's	2,300,000	1,000	114	—
Metropolitan Bonds	668,000	..	108	112
Mutual	3,500,000	100	195	..
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	..
Northern	150,000	50	79	80½
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	32¾	33¼
Preferred	2,000,000	100	60½	63
Bonds 1st 5's	3,500,000	1,000	85½	86½
" 1st Con. 5's	1,500,000	..	100¼	101
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	71¾	72¾
Preferred	5,000,000	100	107	109
Bonds, 1st Mortgage, 5's	1,500,000	1,000	109	111
Yonkers	299,650	50	112	..
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	140	..
Citizens	1,200,000	20	70	..
" S. F. Bonds	320,000	1,000	..	101
Equity	2,000,000	10	..	..
" Bonds	1,000,000	..	..	..
Fulton-Municipal	3,000,000	100	220	..
" Bonds	300,000	..	168	..
Peoples	1,000,000	10	100	..
" Bonds, 7's	368,000	..	100	..
" " 6's	94,000	..	98	100
Metropolitan	870,000	100	200	..
" " Bonds, 5's	70,000	..	..	..
Nassau	1,000,000	25	310	..
" Ctfs	700,000	1,000	99	100
Williamsburgh	1,000,000	50	310	..
" Bonds	1,000,000	..	107	110
Out-of-Town Companies.				
Bay State	5,000,000	50	20¾	21
" Income Bonds	2,000,000	1,000	27	30
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	81	82
2d " " "	3,000,000	1,000	56½	57
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co.	25,000,000	100	64⅞	65
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	94	94¼
Columbus	1,069,000	..	66½	67
1st Mortgage	1,085,000	..	94	95
Consumers, Jersey City	2,000,000	100	90	93
" Bonds	600,000	1,000	100	103
Cincinnati G. & C. Co.	7,000,000	100	203¾	204
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	41
Bonds (6's)	150,000	..	..	..
Consolidated, Baltimore	11,000,000	100	62	64
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	29½	30¼
" Con. Bonds	4,312,000	..	..	70
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	77	80
" Bonds	2,000,000	..	88½	90
Hartford	750,000	25	130	135
Indianapolis	2,000,000	..	..	150
" Bonds, 6's	2,650,000	..	103½	105
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	88	85
Bonds	1,000,000	1,000	85	87
Louisville	2,570,000	50	..	130
Laclede, St. Louis	7,500,000	100	24	..
Preferred	2,500,000	100	80	85
Bonds	9,034,400	1,000	94	..
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Gas Co.	1,000,000	..	75	..
Bonds, 6's	4,000,000	..	130	..
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	46½	..
" Bonds	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	2,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Paterson, N. J.	.....	25	99	102
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	70½	71
St. Paul Gas Light Co.	1,500,000	100	68½	70
1st Mortgage, 6's	650,000	..	88	90
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	..	88	90
Syracuse, N. Y.	500,000	25	..	..
Washington, D. C.	2,000,000	20	220	..
Western, Milwaukee	4,000,000	100	67½	70
Bonds, 5's	3,556,000	..	92½	95
Wilmington, Del.	500,000	50	188	190

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POSITION WANTED

As Supt. or Manager of a Gas Works or Gas and Electric Light Works.

Fifteen years' experience as Manager of Gas Works and six years Gas and Electric Light Works. Good reasons for wishing to change present employment.
1043-tf Address "Y. B.," care this Journal.

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By a man who has had a round experience in the manufacture and sale of gas,

A Position as Supt. of a Large or Small Gas Works.

Is capable and energetic, and is willing to begin at a moderate salary. Address
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A Second-Hand Gas Engine of Some Standard Make,

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One or Two Purifying Boxes 8 ft. by 8 ft. or 8 ft. by 10 ft., with 8-in. Connections.

Give condition, with price.
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Four Purifying Boxes, 8 ft. by 8 ft.,

with 6-inch Center Valves and Connections, in good order.
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Coal Tar For Sale.

PROPOSALS for the entire make of **TAR** in the works of the Pittsburgh Gas Company, for five years from the first day of January next, will be received at the Company's Office, No. 435 Sixth Avenue, Pittsburgh, Pa., until the 7th day of December, at noon. Bids to be by the net ton of 2,000 pounds of coal carbonized. Tar to be delivered in tank at our works. Right to use sufficient tar for Company's own purposes, and to reject any or all bids, reserved. Address bids to D. Herbert Hostetter, Prest.
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The North Adams (Mass.) Gas Light Company invites Proposals for its annual output of Gas Tar, amounting to 600 barrels. The gas made on these works is strictly produced from the carbonization of the best gas coal, no oil being used even for enriching purposes.
1064-tf F. S. RICHARDSON, Treasurer.

Utilize Your Gas Liquor.
NO EXTRA LABOR OR OPERATING EXPENSES.
Ammonia Concentrator.
Not Expensive. Write to
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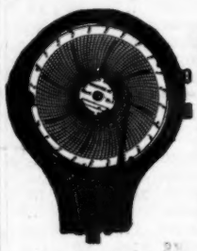

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Simple in Construction,
Accurate in Operation,
Low in Price,
Fully Guaranteed.
Send for Circulars.
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MANUFACTURER OF
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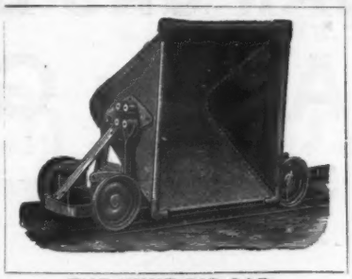

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COKE CARS for Gas Works,
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CHARGING CARS for Bringing Coal from the Storage Bins to Boiler Room and Retort Houses.

INDUSTRIAL RAILWAYS

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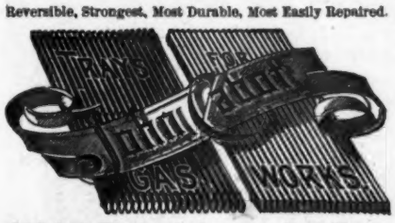

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TRIUMPH REGENERATIVE GAS HEATER

Wilder's Patents, Nov. 15 & 22, 1892.

Heats both air and gas before combustion. Gives high flame temperature and maximum economy, with entire freedom from smoke and smell. Radiates heat to the floor. Warms the feet and does not overheat the head. No headache and no colds caused by cold feet where this Heater is used. Has Group Governor, which regulates gas volumetrically proportionate to heat desired; the only correct regulation for stoves and furnaces. A gas heater, if a free gift, is still costly and extravagant if it burns gas wastefully. The Triumph Heater is constructed upon correct principles, and gives results not obtained with any other.

Write for descriptive circulars and order sample Heater.

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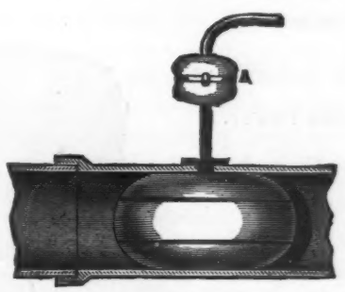
Peerless Patent Improved Gas Bag



These Gas Bags are used to stop the flow of gas while repairing or making alterations in gas mains. There have been numerous cases of workmen being badly injured, and sometimes fatally, by the escape of gas resulting from the bursting of a bag, and our patent improvement is designed to obviate such calamities. The indicator *A* shows unerringly when the bag has been sufficiently inflated to pack the main, and when the pumping should be stopped. Our Bags are made of a rubber stock especially prepared to admit of great distension, and to resist the action of Oils, Gases, Naphtha and other residuum in the mains, and they are made with lapped joints, which adds greatly to their strength.

3-in.	Gas Bag,	each,	$0.60	12-in.	Gas Bag,	each,	$3.00
4 "	"	"	.80	16 "	"	"	8.25
5 "	"	"	1.05	20 "	"	"	12.00
6 "	"	"	1.75	24 "	"	"	17.00
8 "	"	"	2.65	30 "	"	"	27.50
10 "	"	"	3.75				

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WM. W. GOODWIN, Prest. O. N. GULDLIN, V.-Prest. & Treas. H. B. GOODWIN, Sec. ERNEST F. LLOYD, Asst. Sec

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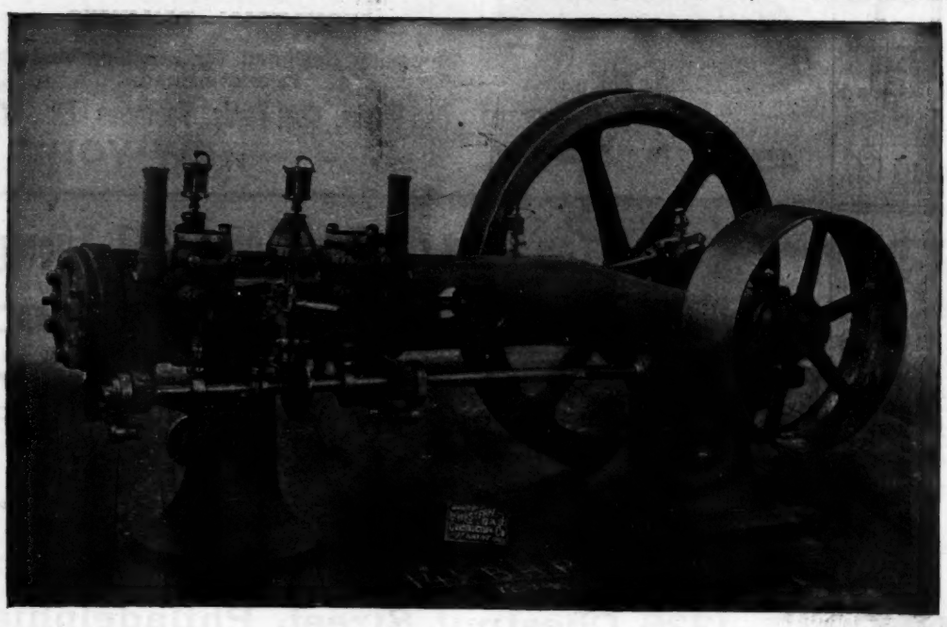
MANUFACTURERS OF

The Double-Acting Gas Engine,

Under the Patents of Griffin, and Dick, Kerr & Co., of London and Kilmarnock.



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Impulse Every Revolution.

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15 to 500 Horse Power.

For General Work and Isolated Electric Plants.

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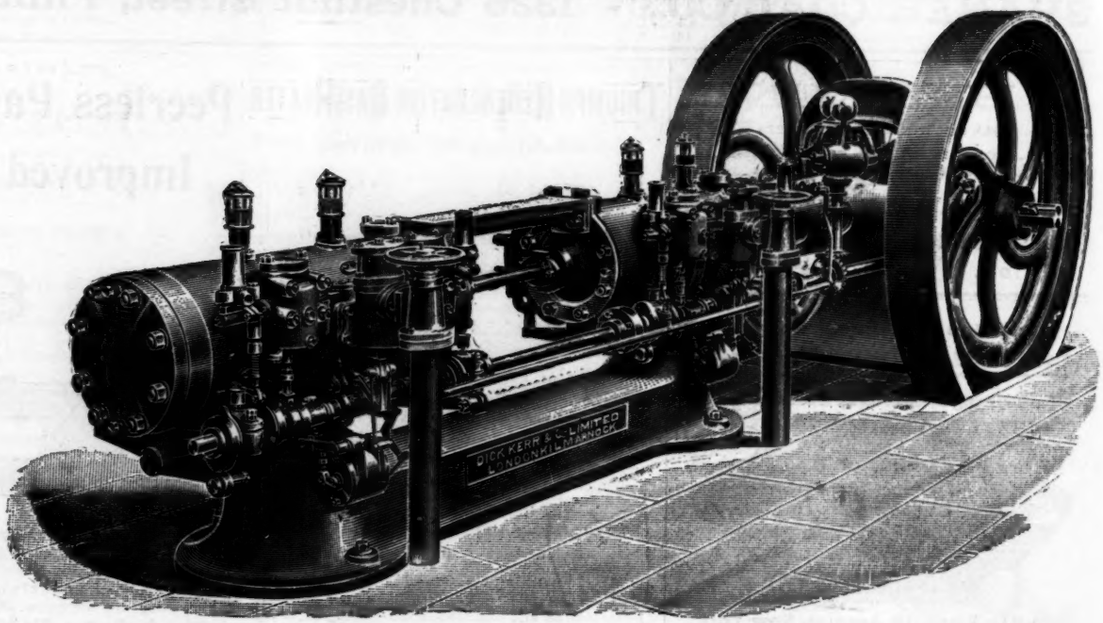
Tandem Cylinder. Impulse Every Stroke. 100 to 1,000 Horse Power.

For Central Stations and all work requiring extreme steadiness.



ESSENTIAL PRINCIPLE.—An impulse at each end of piston; using half force to each impulse; doubling the steadiness; reducing the wear on moving parts, and weight for given power. **CONSTRUCTION.**—The piston rod works through stuffing box in front end of cylinder, and connecting rod is carried in a cross-head working in a slide in frame, as in ordinary steam engine practice. All valves are of the poppet type, operated by cams on a single cam-shaft, giving positive movement to every working part. Tube or electric ignition. **RESULT.**—An engine of extreme simplicity and steadiness of action, the even wear on the cylinder and all working parts assuring increased economy, long life, and minimum cost in repairs. **RECORD.**—Successful and constant use in Great Britain for the past eight years. Address

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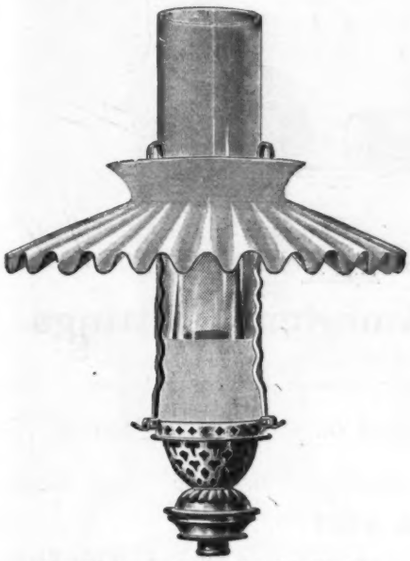

No. 31 Burner, with No. 74 Shade.

No. 31 Burner, with Nos. 10 and 43 Shades.

Made by the

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Gloucester City, N. J.

Sole Manufacturers for the United States.

The WOLFF Gas Radiator.

Size, 33 Inches High, 21 Inches Wide and 10 Inches Deep. The Trilby Heaters are furnished in Brass, Copper-Bronze and Nickel Plate.

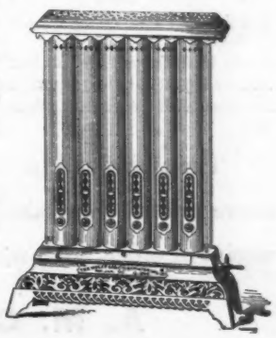
The Most Ornamental and Economical Gas Heater in the World.

The WOLFF Gas Radiators are no Longer an Experiment.

Heating with gas as a fuel instead of wood or coal was made practicable only four years ago, when the first WOLFF Gas Radiator was made. Since that time we have supplied Gas Radiators to heat all kinds of Rooms, Halls, Stores, Churches, Theaters, etc.; they are used in Bed Chambers, Sick Rooms, and wherever heat is required. And, because of their great success, several imitation Gas Radiators are offered, "said to be as good as Wolff's;" but none of them are as good. The WOLFF Radiator gives more and better quality of heat, at less cost, than any gas heater in the market.

In our Trilby Heater we again offer something **new, novel** and **good,** as well as beautiful and pleasing to the eye. Most Stoves, Heaters and Radiators in use heat the **top** of the room, leaving the **floor** cold (hence keep the head warm and the feet cold). Our Trilby Heater warms the floor first; then the heat rises gradually, warming the whole room comfortably, cold air being drawn in from the bottom (passing between the heated radiating flues) and thoroughly warmed before passing out at the top, while the gas, mixed with air, is burned in our "Patent Incandescent Iron Fires Burners," which greatly intensifies the heat, causing an extra amount of heat to be radiated, or thrown off onto the floor, while the products of combustion are carried up through radiating iron flues to the top of the Trilby Heater, and downwards and out through opening to flue or chimney pipe connection, making a current or outlet for burnt gas or impure air, thus causing perfect ventilation in the room.

The Trilby uses less gas and gives more and better heat than any other Gas Radiator in the market.



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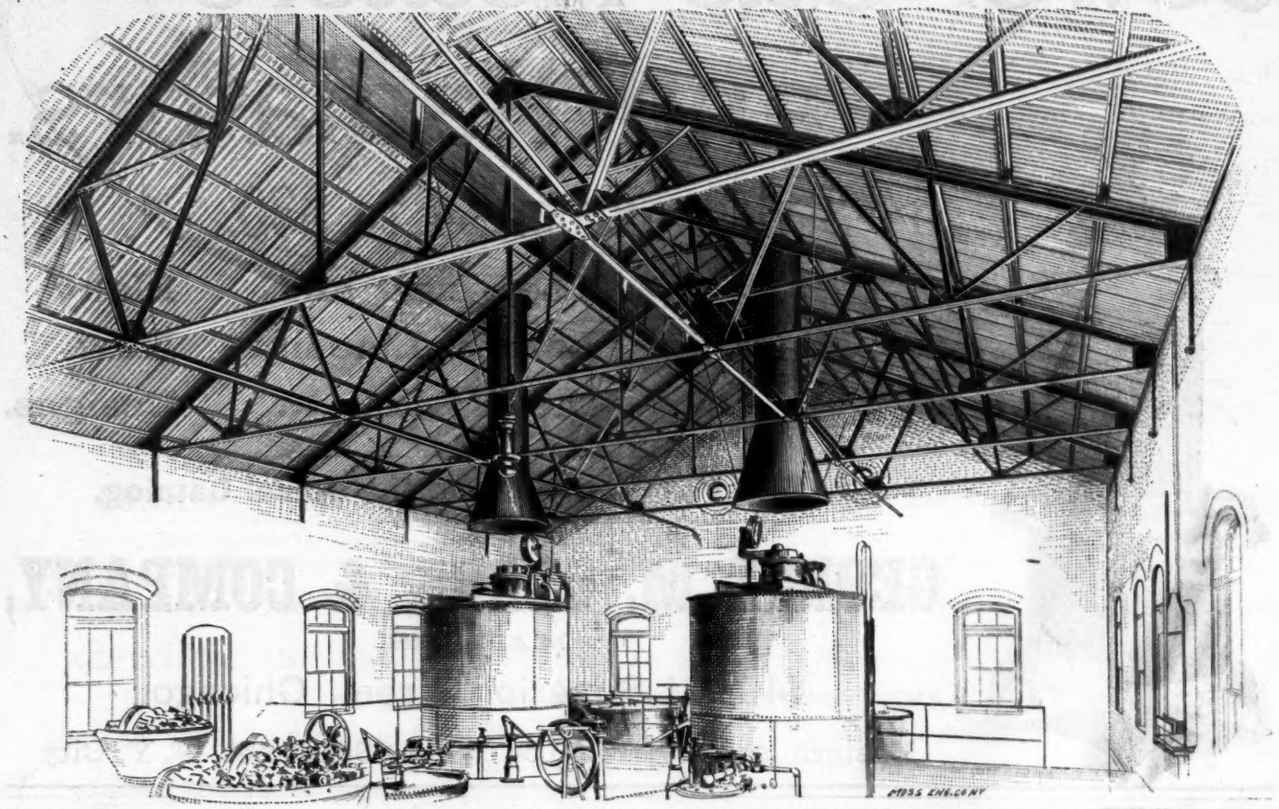

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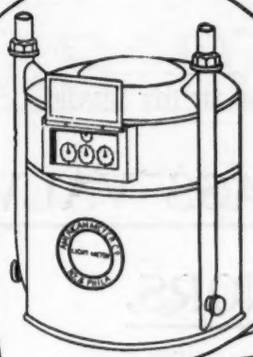

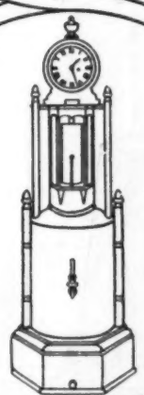

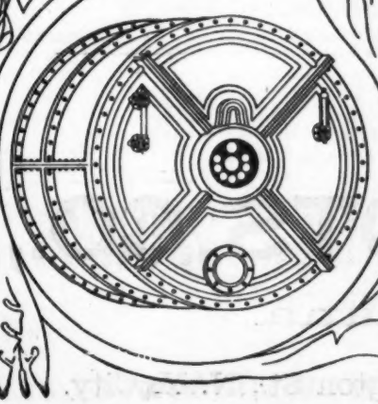

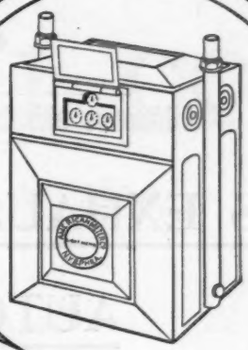

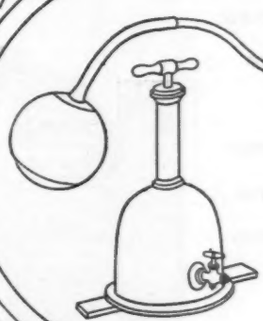

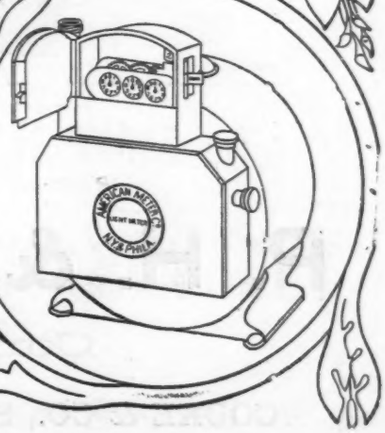

PUBLIC LIGHTING TABLE.

DECEMBER, 1895.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Sun.	1	No L. FM	No L.	4.20	6.10
Mon.	2	No L.	No L.	4.20	6.10
Tue.	3	5.00 PM	6.30 PM	4.20	6.15
Wed.	4	5.00	7.40	4.20	6.15
Thu.	5	5.00	8.50	4.20	6.15
Fri.	6	5.00	10.10	4.20	6.15
Sat.	7	5.00	11.20	4.20	6.15
Sun.	8	5.00 LQ	12.40 AM	4.20	6.15
Mon.	9	5.00	1.50	4.20	6.15
Tue.	10	5.00	3.00	4.20	6.20
Wed.	11	5.00	4.10	4.20	6.20
Thu.	12	5.00	6.10	4.20	6.20
Fri.	13	5.00	6.10	4.20	6.20
Sat.	14	5.00	6.10	4.20	6.20
Sun.	15	5.10 NM	6.20	4.20	6.20
Mon.	16	5.10	6.20	4.20	6.20
Tue.	17	5.10	6.20	4.20	6.20
Wed.	18	5.10	6.20	4.20	6.20
Thu.	19	5.10	6.20	4.20	6.20
Fri.	20	8.00	6.20	4.20	6.20
Sat.	21	9.00	6.20	4.20	6.20
Sun.	22	10.00	6.20	4.20	6.20
Mon.	23	11.00 FQ	6.20	4.20	6.20
Tue.	24	12.00 AM	6.20	4.20	6.25
Wed.	25	1.00	6.20	4.20	6.25
Thu.	26	2.10	6.20	4.20	6.25
Fri.	27	3.20	6.20	4.20	6.25
Sat.	28	4.20	6.20	4.20	6.25
Sun.	29	5.30	6.20	4.20	6.25
Mon.	30	No L.	No L.	4.20	6.25
Tue.	31	No L. FM	No L.	4.20	6.25

TOTAL HOURS LIGHTING DURING 1895.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	237.00	January	423.20
February	196.40	February	355.25
March	195.50	March	355.35
April	165.30	April	298.50
May	153.40	May	264.50
June	138.20	June	234.25
July	146 30	July	243.45
August	152.50	August	280.25
September	165.10	September	321.15
October	186.10	October	374.30
November	204.10	November	401.40
December	219.30	December	433.45
Total, yr.	2161.20	Total, yr.	3987.45

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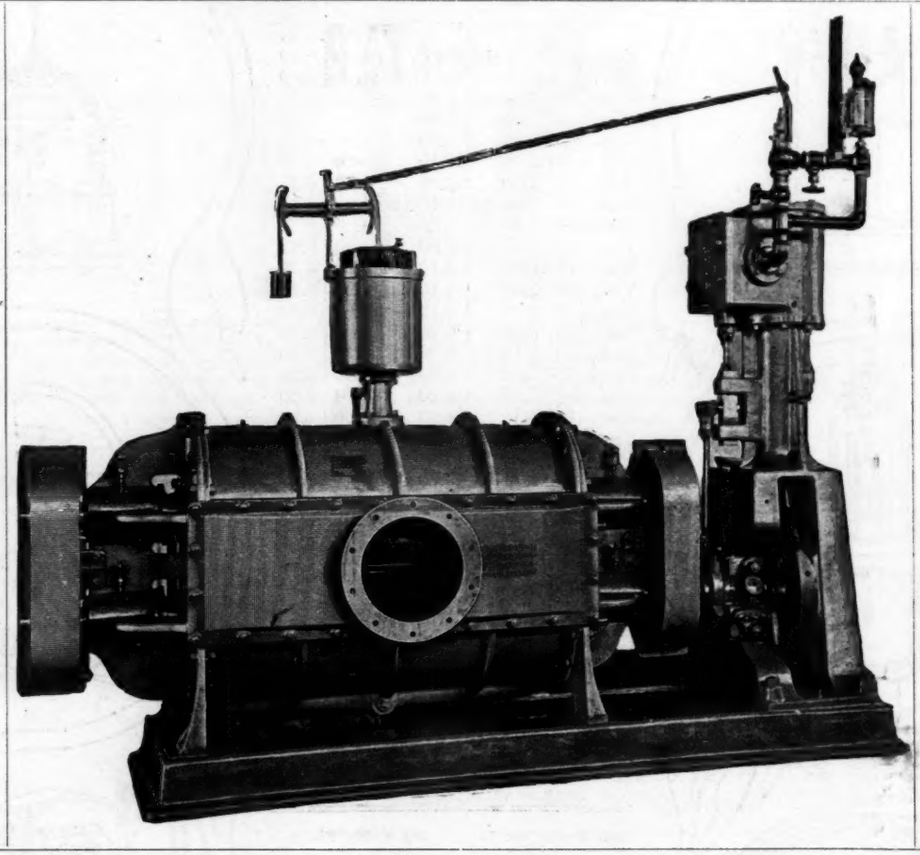

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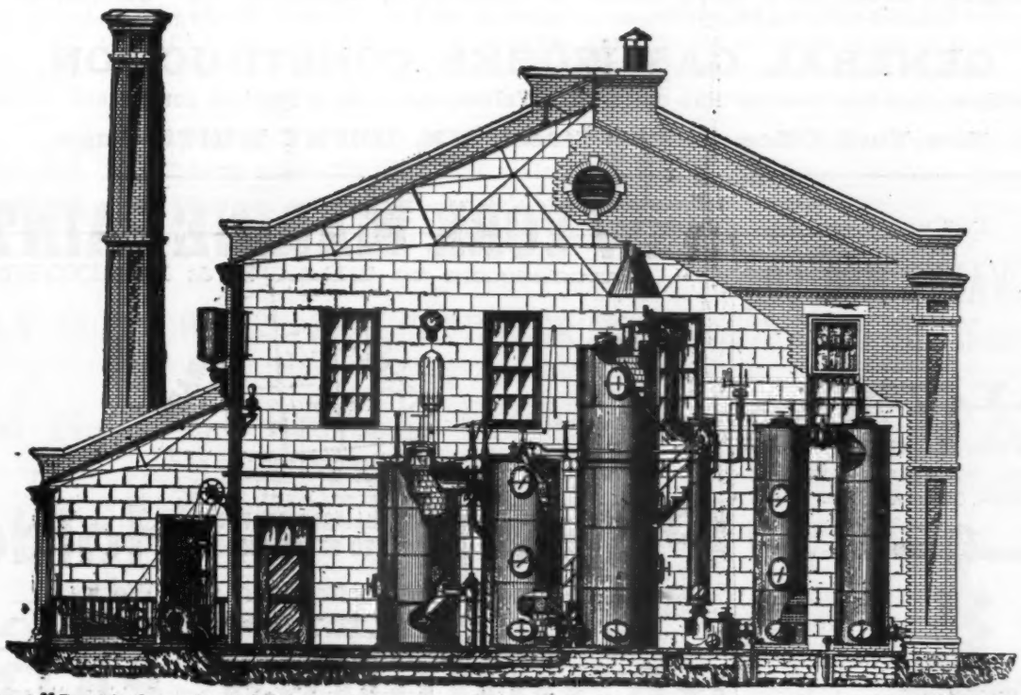

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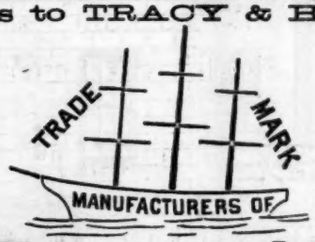

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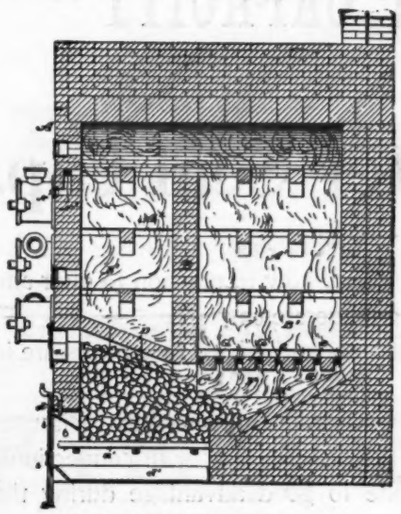

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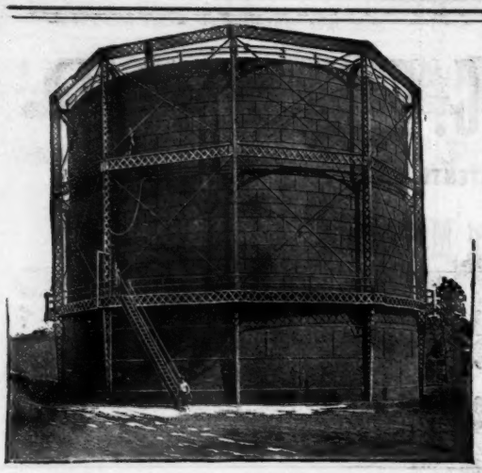

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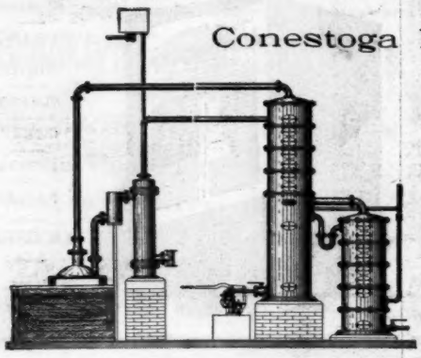

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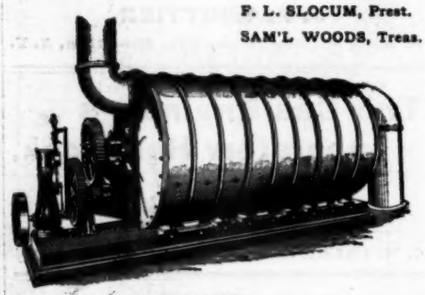

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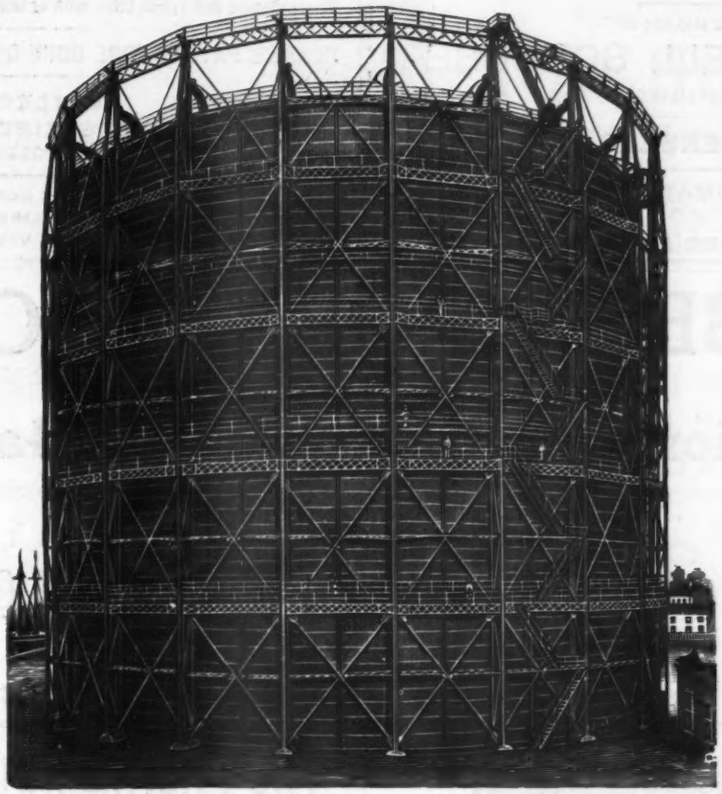

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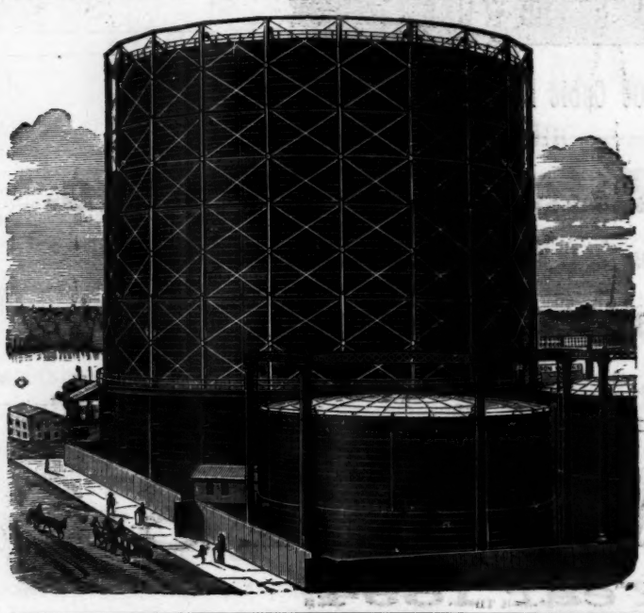

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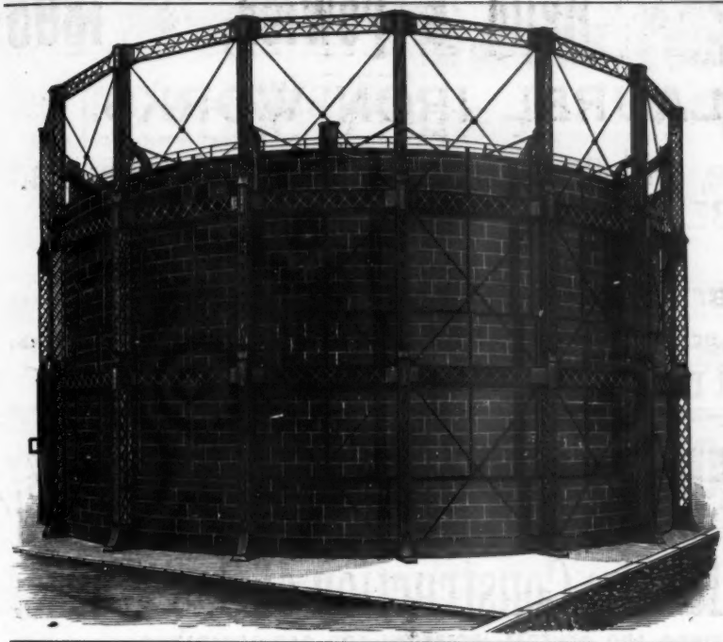

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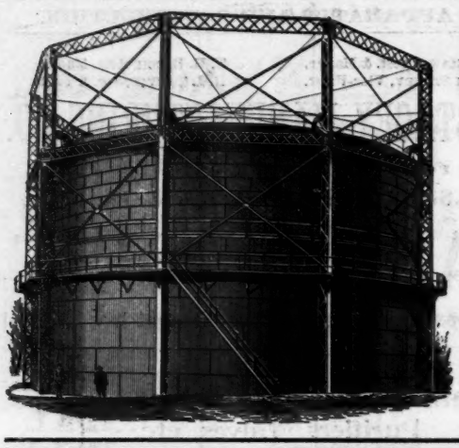

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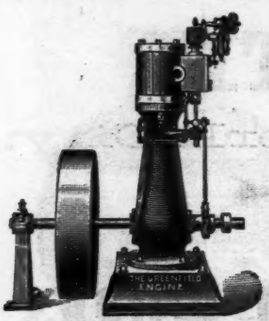

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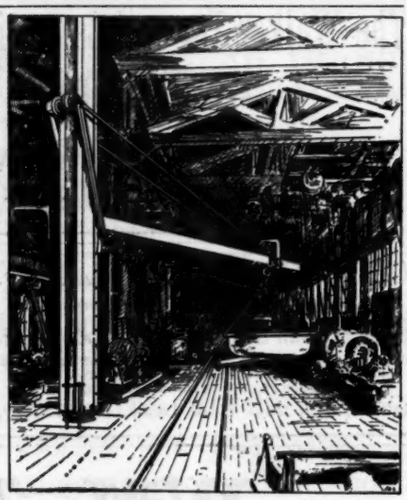

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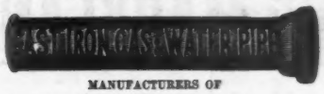

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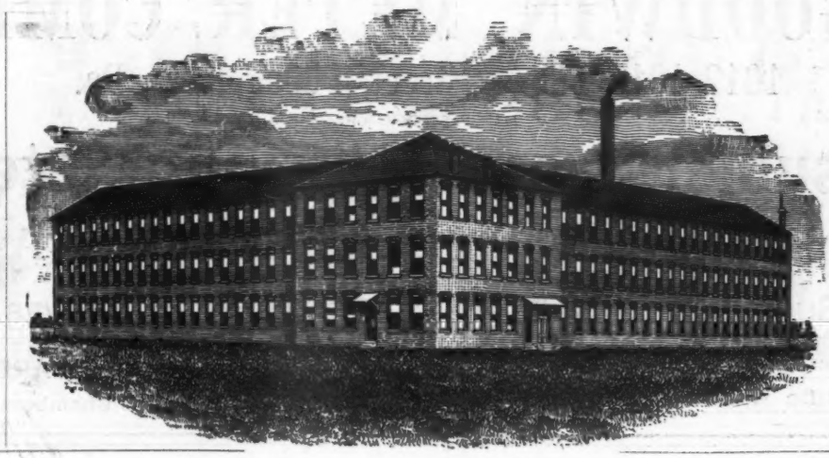

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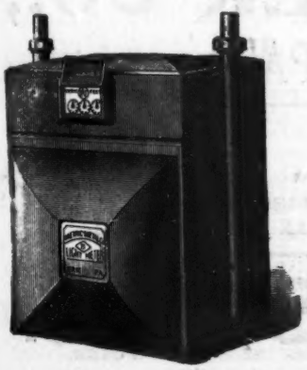

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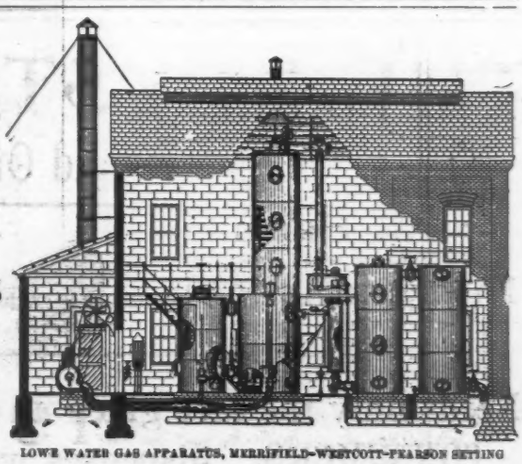

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